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Field Tests of Industrial Stoker Coal-Fired Boilers for Emissions Control and Efficiency Improvement - Site H (Data Supplement)

KVB, Inc.
Minneapolis, MN

Prepared for

Industrial Environmental Research Lab.
Research Triangle Park, NC

May 80

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Boilers	Efficiency	Stationary Sources	13A
Combustion	Flue Gases	Combustion Modification	21B
Coal	Fly Ash	Spreader Stokers	21D
Field Tests	Particle Size	Particulate	14B
Dust	Nitrogen Oxides		11G 07B
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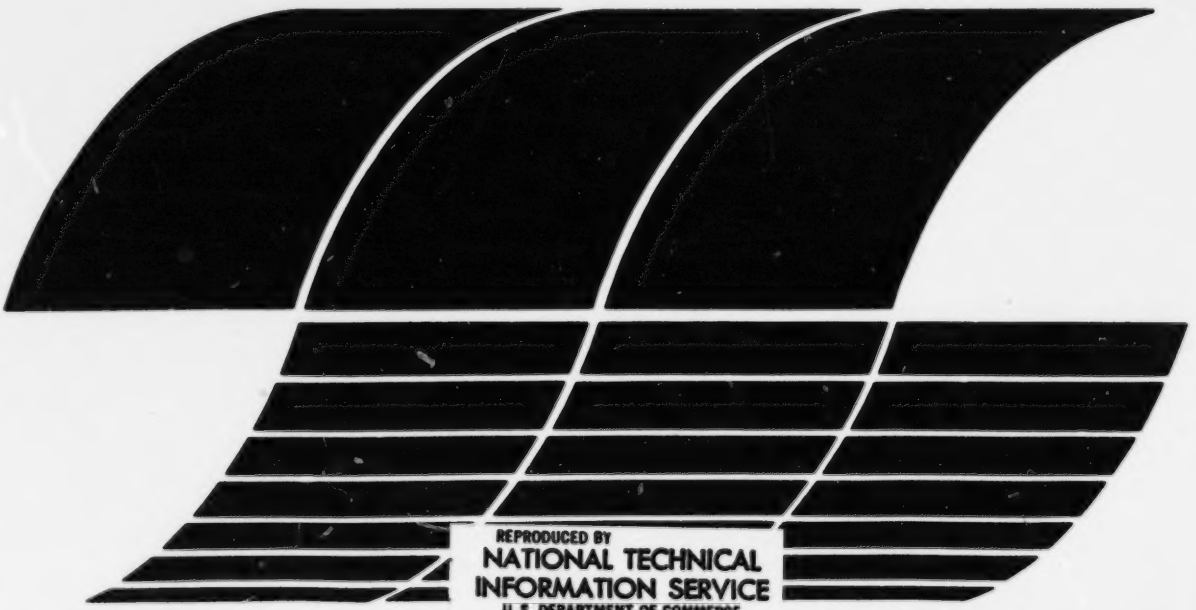

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May 1980

Field Tests of Industrial Stoker Coal-fired Boilers for Emissions Control and Efficiency Improvement — Site H (Data Supplement)

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Program Element No. EHE624

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Washington, DC 20545

and

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Arlington, VA 22209

ABSTRACT

The Data Supplement is a compilation of test data presented in greater detail than was practical in the Final Technical Report. It is intended to provide the necessary details to other researchers who are interested in performing their own analysis. Readers are referred to the contract final report for information as to objectives, description of facility tested and coals fired, test equipment and procedures, interpretations and conclusions. The Final Technical Report also contains data summaries not found in this volume. The Supplement contains panel board data for each test, detailed particulate, O_2, CO_2, CO, NO, NO_2, SO_2 and SO_3 data, particle size distribution data, chemical analysis of the coal, coal size consistency data, and combustible analysis data.

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FOREWORD

The purpose of this Data Supplement Volume is to document data in greater detail than was practical in the Final Technical Report.[1] It is intended to provide the necessary details to other researchers who are interested in performing their own analysis. Readers are referred to the contract final report for information as to objectives, description of facility tested and coals fired, test equipment and procedures, interpretations and conclusions. The Final Technical Report also contains data summaries not found in this volume.

The data in this volume are arranged by type (i.e., Panel Board Data, Particulate Data, etc.) and within each type by test number. Data summaries where they exist are at the front of each section. The boiler tested is referred to as Boiler H; as it is the eighth boiler tested under the program entitled, "A Testing Program to Update Equipment Specifications and Design Criteria for Stoker Fired Boilers."

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[1] Langsjoen, P. L., et al., "Field Tests of Industrial Stoker Coal-Fired Boilers for Emissions Control and Efficiency Improvement - Site H."

CONVERSION FACTORS

ENGLISH AND METRIC UNITS TO SI UNITS

To Convert From	To	Multiply By
in	cm	2.540
in^2	cm^2	6.452
ft	m	0.3048
ft^2	m^2	0.09290
ft^3	m^3	0.02832
lb	Kg	0.4536
lb/hr	Mg/s	0.1260
$lb/10^6$BTU	ng/J	430
g/Mcal	ng/J	239
BTU	J	1054
BTU/lb	J/kg	2324
BTU/hr	W	0.2929
J/sec	W	1.000
J/hr	W	3600
BTU/ft/hr	W/m	0.9609
BTU/ft/hr	J/hr/m	3459
$BTU/ft^2/hr$	W/m^2	3.152
$BTU/ft^2/hr$	$J/hr/m^2$	11349
$BTU/ft^3/hr$	W/m^3	10.34
$BTU/ft^3/hr$	$J/hr/m^3$	37234
psia	Pa	6895
$"H_2O$	Pa	249.1
Rankine	Celsius	C = 5/9R-273
Fahrenheit	Celsius	C = 5/9(F-32)
Celsius	Kelvin	K = C+273
Rankine	Kelvin	K = 5/9R

FOR TYPICAL COAL FUEL

ppm @ 3% O_2 (SO_2)	ng/J	($lb/10^6$Btu)	0.851 ($1.98x10^{-3}$)
ppm @ 3% O_2 (SO_3)	ng/J	($lb/10^6$Btu)	1.063 ($2.47x10^{-3}$)
ppm @ 3% O_2 (NO)*	ng/J	($lb/10^6$Btu)	0.399 ($9.28x10^{-4}$)
ppm @ 3% O_2 (NO_2)	ng/J	($lb/10^6$Btu)	0.611 ($1.42x10^{-3}$)
ppm @ 3% O_2 (CO)	ng/J	($lb/10^6$Btu)	0.372 ($8.65x10^{-4}$)
ppm @ 3% O_2 (CH_4)	ng/J	($lb/10^6$Btu)	0.213 ($4.95x10^{-4}$)
g/kg of fuel**			

*Federal environmental regulations express NOx in terms of NO_2; thus NO units should be converted using the NO_2 conversion factor.

**Based on higher heating value of 10,000 Btu/lb. For a heating value other than 10,000 Btu/lb, multiply the conversion factor by 10,000/(Btu/lb).

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CONVERSION FACTORS

SI UNITS TO ENGLISH AND METRIC UNITS

To Convert From	To	Multiply By
cm	in	0.3937
cm^2	in^2	0.1550
m	ft	3.281
m^2	ft^2	10.764
m^3	ft^3	35.315
Kg	lb	2.205
Mg/s	lb/hr	7.937
ng/J	$lb/10^6BTU$	0.00233
ng/J	g/Mcal	0.00418
J	BTU	0.000948
J/kg	BTU/lb	0.000430
J/hr/m	BTU/ft/hr	0.000289
$J/hr/m^2$	$BTU/ft^2/hr$	0.0000881
$J/hr/m^3$	$BTU/ft^3/hr$	0.0000269
W	BTU/hr	3.414
W	J/hr	0.000278
W/m	BTU/ft/hr	1.041
W/m^2	$BTU/ft^2/hr$	0.317
W/m^3	$BTU/ft^3/hr$	0.0967
Pa	psia	0.000145
Pa	$"H_2O$	0.004014
Kelvin	Fahrenheit	F = 1.8K-460
Celsius	Fahrenheit	F = 1.8C+32
Fahrenheit	Rankine	R = F+460
Kelvin	Rankine	R = 1.8K

FOR TYPICAL COAL FUEL

ng/J	ppm @ 3% O_2 (SO_2)	1.18
ng/J	ppm @ 3% O_2 (SO_3)	0.941
ng/J	ppm @ 3% O_2 (NO)	2.51
ng/J	ppm @ 3% O_2 (NO_2)	1.64
ng/J	ppm @ 3% O_2 (CO)	2.69
ng/J	ppm @ 3% O_2 (CH_4)	4.69
ng/J	g/kg of fuel	0.000233

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SI PREFIXES

Multiplication Factor	Prefix	SI Symbol
10^{18}	exa	E
10^{15}	peta	P
10^{12}	tera	T
10^{9}	giga	G
10^{6}	mega	M
10^{3}	kilo	k
10^{2}	hecto*	h
10^{1}	deka*	da
10^{-1}	deci*	d
10^{-2}	centi*	c
10^{-3}	milli	m
10^{-6}	micro	μ
10^{-9}	nano	n
10^{-12}	pico	p
10^{-15}	femto	f
10^{-18}	atto	a

*Not recommended but occasionally used

EMISSION UNITS CONVERSION FACTORS
FOR TYPICAL COAL FUEL (HV= 13,320 BTU/LB)

To Obtain \ Multiply By	% Weight in Fuel		lbs/10^6Btu		grams/10^6Cal		PPM (Dry @ 3% O_2)		Grains/SCF. (Dry @ 12% CO_2)	
	S	N	SO_2	NO_2	SO_2	NO_2	SOx	NOx	SO_2	NO_2
% Weight In Fuel — S	1		0.666		0.370		13.2×10^{-4}		1.48	
% Weight In Fuel — N				0.405		0.225		5.76×10^{-4}		.903
lbs/10^6Btu — SO_2	1.50		1		(.556)		19.8×10^{-4}		(2.23)	
lbs/10^6Btu — NO_2		2.47				(.556)		14.2×10^{-4}		(2.23)
grams/10^6Cal — SO_2	2.70		(1.8)		1		35.6×10^{-4}		(4.01)	
grams/10^6Cal — NO_2		4.44		(1.8)				25.6×10^{-4}		(4.01)
PPM (Dry @ 3% O_2) — SOx	758		505		281		1		1127	
PPM (Dry @ 3% O_2) — NOx		1736		704		391				1566
Grains/SCF (Dry @ 12% CO_2) — SO_2	.676		(.448)		(.249)		8.87×10^{-4}		1	
Grains/SCF (Dry @ 12% CO_2) — NO_2		1.11		(.448)		(.249)		6.39×10^{-4}		

NOTE: 1. Values in parenthesis can be used for all flue gas constituents such as oxides of carbon, oxides of nitrogen, oxides of sulfur, hydrocarbons, particulates, etc.
2. Standard reference temperature of 530°R was used.

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SECTION 1.0

PANEL BOARD DATA SHEETS

	PAGE
1.1 CONTROL ROOM DATA SHEETS	2

KVB

(Integrator)
Steam Flow, lb/hr 69,310

PANEL BOARD DATA
ABMA TEST SITE H

Coal Flow, lb/hr _____

BOILER #4

Lb/Steam/Lb Coal _____

TEST NO.	1	1			
TEST DATE	MAR 19 1979	3-19-79			
TEST COAL	SANDS HILL	SANDS HILL			
TEST CONDITIONS:	BASELINE (Hi O$_2$)	BASELINE (Hi O$_2$)			
	NORM OFA	NORM OFA			
COAL SCALE					
Start & stop time	—	—			
Pounds Coal Added	—	—			
STEAM INTEGRATOR					
Reading (x 1000 = #/hr)	583991	584192			
Time of Reading	10:46	13 45			
CHART RECORDER					
Steam Flow, lb/hr	40000	39000			
Air Flow, Relative					
DRAFT GAUGES					
Furnace Draft, "H_2O	-0.7	-0.7			
Boiler Outlet Draft, "H_2O	-1.7	-1.7			
Compartment #1 Draft, "H_2O	0.0	0.0			
#2 Draft, "H_2O	+0.6	+2.6			
#3 Draft, "H_2O	+0.7	+2.5			
#4 Draft, "H_2O	+0.3	P.0			

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TEST NO.	1	1			
CONTROLS					
Plant Master	26.5	10.4			
Forced Draft Damper	12.9	15.3			
Stoker	11.2	11.0			
Induced Draft Damper	21.0	21.1			
Feedwater Control Valve	15.2	12.8			
STOKER					
Coal Gate Position L/R	11"/11"	10"/10"			
Grate Speed	—	—			
Windbox Control Position #1	CLOSED/CLOSED	CLOSED/CLOSED			
(L/R) #2	100% OPEN / 60% OPEN	100% OPEN / 60% OPEN			
#3	50% OPEN / 50% OPEN	50% OPEN / 50% OPEN			
#4	20% OPEN / 15% OPEN	CLOSED / CLOSED			
Overfire Air Pressure, "H_2O	2.4	2.4			
STACK Flue Gas Temperature, °F		512			

TEST SITE N

KVB

NOTES

TEST NO: 1

Coal slagging up during test. Large clinkers forming.

TEST NO:

TEST NO:

TEST NO:

TEST NO:

KVB

PANEL BOARD DATA
ABMA TEST SITE H

Steam Flow, lb/hr ~43,200
Coal Flow, lb/hr 4774 (3-20) / 4573 (2-21) Avg. = 4673.5 #/hr
Lb/Steam/Lb Coal 9.2

TEST NO.	2a	2b	2b	2c	2d
TEST DATE	3-20-79	3-21-79	→	→	→
TEST COAL	SANDS HILL	→	→	→	→
TEST CONDITIONS:	O_2 VARIATIONS	→	→	→	→
	NORM OFA	→	→	→	→
	MIN. O_2	BASELINE	→	MAX O_2	Med. Hi O_2
COAL SCALE					
Start & stop time	1055/1205	0830/10:20			
Pounds Coal Added	5570	8385			
STEAM INTEGRATOR					
Reading	09:25	08:34	09:01	09:56	11:21
Time of Reading	584712	585422	585457	585528	585634
CHART RECORDER					
Steam Flow, lb/hr	44000	44000	46000	42000	42000
Air Flow, Relative	31.5	33.5	33.5	38.5	34.0
DRAFT GAUGES					
Furnace Draft, "H_2O	-0.2	-0.2	-0.2	-0.2	-0.2
Boiler Outlet Draft, "H_2O	-1.0	-1.0	-1.0	-1.2	-1.0
Compartment #1 Draft, "H_2O	+0.4	+0.2	+0.2	+0.7	+0.8
#2 Draft, "H_2O	+1.0	+0.9	+0.9	+1.6	+1.5
#3 Draft, "H_2O	+1.0	+0.9	+0.9	+1.5	+1.2
#4 Draft, "H_2O	0.0	0.0	0.0	0.0	0.0
STEAM PRESS, PSI	-	140	142	138	138

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TEST NO.	2a	2b	2b	2c	2d
CONTROLS					
Plant Master	8.2	15.8	12.0	18.4	19.0
Forced Draft Damper	12.7	13.0	13.0	15.0	14.1
Stoker	12.0	12.0	12.0	12.0	12.0
Induced Draft Damper	17.0	17.2	17.4	19.2	17.7
Feedwater Control Valve	17.0	26.0	21.5	17.0	17.5
STOKER					
Coal Gate Position (L/R)	9"/9"	9"/9"	9"/9"	9"/9"	9"/9"
Grate Speed	—	—	—	—	—
Windbox Control Position #1	15% OPEN / 15% OPEN	15% OPEN / 20% OPEN	20% OPEN / 20% OPEN	→	→
(L/R) #2	70% OPEN / 60% OPEN	100% OPEN / 60% OPEN	100% OPEN / 60% OPEN	→	→
#3	50% OPEN / 60% OPEN	50% OPEN / 60% OPEN	50% OPEN / 60% OPEN	→	100% OPEN / 100% OPEN
#4	CLOSED / CLOSED	CLOSED / CLOSED	CLOSED / CLOSED	→	→
Overfire Air Pressure, "H_2O	2.8	3.0	.8	2.9	2.8
Flue Gas Temperature, °F					

Test Site W

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PANEL BOARD DATA
ABMA TEST SITE H

Steam Flow, lb/hr _____
Coal Flow, lb/hr _____
Lb/Steam/Lb Coal _____

TEST NO.	2e	2f			
TEST DATE	3-21-79	3-21-79			
TEST COAL	SANDS HILL →				
TEST CONDITIONS:	Q VARIATIONS →				
	NORM OFA →				
	REPEAT BASELINE	MIN Q			
COAL SCALE					
Start & stop time					
Pounds Coal Added					
STEAM INTEGRATOR					
Reading	585791	585843			
Time of Reading	13:23	14:04			
CHART RECORDER					
Steam Flow, lb/hr	41500	43,000			
Air Flow, Relative	32.8	30.8			
DRAFT GAUGES					
Furnace Draft, "H_2O	-0.2	-0.2			
Boiler Outlet Draft, "H_2O	-0.9	-0.8			
Compartment #1 Draft, "H_2O	+0.5	+0.3			
#2 Draft, "H_2O	+1.0	+0.8			
#3 Draft, "H_2O	+0.9	+0.7			
#4 Draft, "H_2O	+0.7	+0.5			
STEAM PRESS, PSI	140	140			

KVB

TEST NO.	2e	2f			
CONTROLS					
Plant Master	1[illegible]	13.6			
Forced Draft Damper	1.0	12.5			
Stoker	12.0	12.0			
Induced Draft Damper	17.8	16.5			
Feedwater Control Valve	14.5	13.0			
STOKER					
Coal Gate Position	9"/9"	9"/9"			
Grate Speed					
Windbox Control Position #1	20% OPEN / SAME	→			
L/R) #2	100% OPEN / 60% OPEN	→			
#3	100% OPEN / SAME	→			
#4	20% OPEN / SAME	→			
Overfire Air Pressure, "H_2O	2.8	2.8			
Flue Gas Temperature, °F					

TEST SITE N

KVB

NOTES

TEST NO: 2a COAL BURNING MUCH BETTER THAN IN TEST #1. LONGER FLAME OVER A SHORTER PORTION OF BED. LESS AIR REQ'D. TROUBLE WITH ASH HANDLING SYSTEM ⇒ LARGE FLUCTUATIONS IN BLR LOAD + EXCESS O_2. HAD TO ABORT REST OF TEST CLINKER BEGAN FORMING AT LOW O_2 COND. AFTER AWHILE

TEST NO: 2b BOILER RUNNING FAIRLY STEADILY IN EARLY A.M. FIRE A LITTLE SHORTER.

TEST NO: 2f Clinker formation - not an operable boiler setting. Will use their baseline air for our "low O_2" part Tests.

TEST NO:

TEST NO:

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PANEL BOARD DATA
ABMA TEST SITE H

Steam Flow, lb/hr ~45,700
Coal Flow, lb/hr 5271
Lb/Steam/Lb Coal 8.7

TEST NO.	3	3	3		
TEST DATE	3-22-79	3-22-79	3-22-79		
TEST COAL	SANDS HILL	→	→		
TEST CONDITIONS:	MIN. O_2	→	→		
	DORM (LOW) OFF	→	→		
	PARTICULATES	→	→		
COAL SCALE					
Start & stop time	10:03				
Pounds Coal Added					
STEAM INTEGRATOR					
Reading	586328	586519	586612		
Time of Reading	10:16	12:46	13:55		
CHART RECORDER					
Steam Flow, lb/hr	45600	46,000	45,500		
Air Flow, Relative	32.8	31.0	32.5		
DRAFT GAUGES					
Furnace Draft, "H_2O	-0.2	-0.2	-0.2		
Boiler Outlet Draft, "H_2O	-1.0	-1.0	-0.9		
Compartment #1 Draft, "H_2O	+0.1	+0.8	+0.9		
#2 Draft, "H_2O	+0.8	+1.2	+1.4		
#3 Draft, "H_2O	+0.8	+1.0	+1.2		
#4 Draft, "H_2O	0.0	0.0	0.0		
STEAM PRESS, PSI	140	145	152		

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TEST NO.	3	3	3		
CONTROLS					
Plant Master	13.0	6.0	20.0		
Forced Draft Damper	13.1	13.1	13.5		
Stoker	12.1	12.1	12.1		
Induced Draft Damper	17.4	16.8	16.6		
Feedwater Control Valve	16.3	19.0	17.0		
STOKER					
Coal Gate Position (L/R)	9"/9"	9"/9"	9"/9"		
Grate Speed					
Windbox Control Position #1	20%/20%	100%/20%	20%/20%		
(L/R) #2	100%/100%	→	→		
#3	100%/100%	→	→		
#4	CLOSED/CLOSED	→	→		
Overfire Air Pressure, "H_2O	2.7	2.8	2.7		
Flue Gas Temperature, °F	510	→	→		

TEST SITE N

KVB

NOTES

TEST NO: SOME CLINKER FORMATION AT 12:45.

TEST NO:

TEST NO:

TEST NO:

TEST NO:

TEST SITE 1

KVB

PANEL BOARD DATA
ABMA TEST SITE H

Steam Flow, lb/hr 22,433
Coal Flow, lb/hr _____
Lb/Steam/Lb Coal _____

TEST NO.	4a	4b	4c		
TEST DATE	3-23-79	→	→		
TEST COAL	SANDS HILL	→	→		
TEST CONDITIONS:	50% LOAD	→	→		
COAL SCALE					
Start & stop time	—	—	—		
Pounds Coal Added	—	—	—		
STEAM INTEGRATOR					
Reading	586996	587048	587066		
Time of Reading	09:56	11:17	11:46		
CHART RECORDER					
Steam Flow, lb/hr	22000	22[illegible]	22300		
Air Flow, Relative	16.0	[illegible]	18.5		
DRAFT GAUGES					
Furnace Draft, "H_2O	-0.2	[illegible]	-0.2		
Boiler Outlet Draft, "H_2O	-0.5	-0.4	-0.5		
Compartment #1 Draft, "H_2O	0.0	[illegible]	0.0		
#2 Draft, "H_2O	+0.1	[illegible]	+0.1		
#3 Draft, "H_2O	0.0	[illegible]	0.0		
#4 Draft, "H_2O	0.0	[illegible]	0.0		
STEAM PRESS, PSI	140	[illegible]	143		

KVB

TEST NO.	4				
CONTROLS					
Plant Master	7.3		11.0		
Forced Draft Damper	7.2		9.0		
Stoker	12.1		12.1		
Induced Draft Damper	12.3		14.2		
Feedwater Control Valve	15.1		8.8		
STOKER					
Coal Gate Position (L/R)	5"/5"		5"/5"		
Grate Speed					
Windbox Control Position #1	20%/20%		10%/10%		
(L/R) #2	50%/50%		90%/70%		
#3	closed/closed		20%/20%		
#4	closed/closed		closed/closed		
Overfire Air Pressure, "H_2O	2.8		11.2		
Flue Gas Temperature, °F					

TEST SITE N

KVB

PANEL BOARD DATA
ABMA TEST SITE H

Steam Flow, lb/hr 44,533
Coal Flow, lb/hr 7460 LB/HR
Lb/Steam/Lb Coal 6.0

TEST NO.	5	5	5		
TEST DATE	3-26-79	3-26-79	3-26-79		
TEST COAL	SANDS HILL	→	→		
TEST CONDITIONS:	LOW O_2	→	→		
	HIGH OFA	→	→		
	BRUNK & PARTIC.	→	→		
COAL SCALE					
Start & stop time	9:38/10:38				
Pounds Coal Added	7460 LB				
STEAM INTEGRATOR					
Reading	588566	588725	588910		
Time of Reading	08:59	11:09	13:36		
CHART RECORDER					
Steam Flow, lb/hr	47000	43000	43,600		
Air Flow, Relative	37.4	36.0	37.0		
DRAFT GAUGES					
Furnace Draft, "H_2O	-0.2	-0.2	-0.2		
Boiler Outlet Draft, "H_2O	-1.1	-1.1	-1.1		
Compartment #1 Draft, "H_2O	+0.2	+0.5	+0.4		
#2 Draft, "H_2O	+0.9	+1.0	+0.8		
#3 Draft, "H_2O	+1.0	+0.9	+0.7		
#4 Draft, "H_2O	0.0	0.0	+0.7		
STEAM PRESS., PSI	137	135	144		

KVB

TEST NO.	5	5	5		
CONTROLS					
Plant Master	21.0	25.1	8.5		
Forced Draft Damper	13.0	13.0	13.0		
Stoker	12.0	12.0	12.0		
Induced Draft Damper	19.0	18.5	19.0		
Feedwater Control Valve	20.0	16.0	16.0		
STOKER					
Coal Gate Position (L/R)	9"/9"	9"/9"	9"/9"		
Grate Speed					
Windbox Control Position #1	25%/25%	35%/35%	→		
(L/R) #2	100%/100%	100%/75%	→		
#3	40%/40%	100%/100%	→		
#4	CLOSED/CLOSED	CLOSED/CLOSED	30%/30%		
Overfire Air Pressure, "H_2O	11.7	11.7	11.7		
Flue Gas Temperature, °F	425°	→	→		

TEST SITE N

KVB

NOTES

TEST NO: (5) Coal seems to have more ash than in previous tests. Trouble maintaining steam load w/ same stoker and F.D. - I.D. FAN settings. Much larger coal flow rate. Emptied one coal storage bin + started another. Flame length much shorter than previously.

TEST NO:

TEST NO:

TEST NO:

TEST NO:

TEST SHEET

KVB

PANEL BOARD DATA
ABMA TEST SITE H

Steam Flow, lb/hr 43,800
Coal Flow, lb/hr 4897.0
Lb/Steam/Lb Coal 8.9

TEST NO.	6	6	6		
TEST DATE	3-27-79	3-27-79	3-27-79		
TEST COAL	SANDS HILL	→	→		
TEST CONDITIONS:	HIGH O_2	→	→		
	HIGH OFA	→	→		
	PARTIC.	→	→		
COAL SCALE					
Start & stop time	7:45	11.00			
Pounds Coal Added	0	15,915			
STEAM INTEGRATOR					
Reading	589696	589790	589878		
Time of Reading	08:43	09:54	11:06		
CHART RECORDER					
Steam Flow, lb/hr	46,500	43,700	41,200		
Air Flow, Relative	39.0	39.0	39.0		
DRAFT GAUGES					
Furnace Draft, "H_2O	0.0	0.0	0.0		
Boiler Outlet Draft, "H_2O	-1.0	-1.0	-1.0		
Compartment #1 Draft, "H_2O	+1.7	[illegible]	-0.8		
#2 Draft, "H_2O	+1.4	[illegible]	+1.4		
#3 Draft, "H_2O	+1.4	[illegible]	+1.5		
#4 Draft, "H_2O	+1.1	+1.1	+1.2		
STM PRESS, PSI	122	135	140		

KVB

TEST NO.	6	6	6		
CONTROLS					
Plant Master	27.5	26.2	16.0		
Forced Draft Damper	15.0	15.0	15.0		
Stoker	12.0	12.0	12.0		
Induced Draft Damper	26.9	27.5	27.3		
Feedwater Control Valve	20.5	16.5	14.8		
STOKER					
Coal Gate Position (L/R)	9"/9"	9"/9"	9"/9"		
Grate Speed					
Windbox Control Position #1	40%/40%	→	→		
(L/R) #2	100%/100%	→	→		
#3	60%/60%	→	→		
#4	30%/35%	→	→		
Overfire Air Pressure, "H_2O	11.2	11.2	11.2		
Flue Gas Temperature, °F	425				

TEST SITE W

KVB

PANEL BOARD DATA
ABMA TEST SITE H

Steam Flow, lb/hr 33,975
Coal Flow, lb/hr 3687
Lb/Steam/Lb Coal 9.2

TEST NO.	7a	7a	7a	7a	7a
TEST DATE	3-28-79	3-28-79	3-28-79	3-28-79	3-28-79
TEST COAL	SANDS HILL				
TEST CONDITIONS:	75% LOAD				
	VARY O_2				
	BASELINE	BASELINE	BASELINE	BASELINE	BASELINE
COAL SCALE					
Start & stop time	08:40/11:40				
Pounds Coal Added	11060				
STEAM INTEGRATOR					
Reading	590629	590672	590704	590732	590771
Time of Reading	08:34	09:19	09:53	10:28	11:03
CHART RECORDER					
Steam Flow, lb/hr	36000	34000	32000	35000	33000
Air Flow, Relative	22.0	21.4	21.3	21.6	22.4
DRAFT GAUGES					
Furnace Draft, "H_2O	-0.2	-0.2	-0.2	-0.2	-0.2
Boiler Outlet Draft, "H_2O	-0.6	-0.6	-0.6	-0.6	-0.6
Compartment #1 Draft, "H_2O	+0.1	+0.1	+0.1	+0.1	+0.1
#2 Draft, "H_2O	+0.3	+0.3	+0.3	+0.3	+0.3
#3 Draft, "H_2O	0.0	0.0	0.0	0.0	0.0
#4 Draft, "H_2O	0.0	0.0	0.0	0.0	0.0
[illegible]	146	130	135	140	130

KVB

TEST NO.	7a	7a	7a	7a	7a
CONTROLS					
Plant Master	6.2	27.6	22.2	14.0	27.5
Forced Draft Damper	10.2	10.2	10.2	10.2	10.2
Stoker	11.0	11.7	12.3	11.8	11.8
Induced Draft Damper	14.8	14.7	14.8	14.8	14.0
Feedwater Control Valve	12.4	12.4	11.4	13.3	11.0
STOKER					
Coal Gate Position (L/R)	7"/7"	7"/7"	7"/7"	7"/7"	7"/7"
Grate Speed					
Windbox Control Position #1	45%/45%				
(L/R) #2	55%/50%				
#3	10%/10%				
#4	CLOSED/CLOSED				
Overfire Air Pressure, "H_2O	3.0	3.0	3.0	3.0	3.0
Flue Gas Temperature, °F					

Test Site N

KVB

NOTES

TEST NO: 7a Fairly long flame but over a small portion of bed - basically only 2 zones. No clinker at ~8% O_2.

TEST NO:

TEST NO:

TEST NO:

TEST NO:

KVB

PANEL BOARD DATA
ABMA TEST SITE H

Steam Flow, lb/hr _____
Coal Flow, lb/hr 3687
Lb/Steam/Lb Coal _____

TEST NO.	7b	7c	7d		
TEST DATE	3-28-79	3-28-79	3-28-79		
TEST COAL	SANDS HILL	SANDS HILL	SANDS HILL		
TEST CONDITIONS:	VARY O_2	→	→		
	75% LOAD	→	→		
	Hi O_2	Med.-Hi O_2	Lo O_2		
COAL SCALE					
Start & stop time	08:40/11 40				
Pounds Coal Added	11060				
STEAM INTEGRATOR					
Reading	590813	590 842	590942		
Time of Reading	11:49	12:19	14:06		
CHART RECORDER					
Steam Flow, lb/hr	32000	34800	35000		
Air Flow, Relative	32.4	29.5	19.8		
DRAFT GAUGES					
Furnace Draft, "H_2O	-0.2	-0.2	-0.2		
Boiler Outlet Draft, "H_2O	-0.9	-0.8	-0.5		
Compartment #1 Draft, "H_2O	+0.9	+0.7	0.0		
#2 Draft, "H_2O	+1.6	+1.2	+0.2		
#3 Draft, "H_2O	+0.5	+0.3	+0.2		
#4 Draft, "H_2O	0.0	0.0	0.0		
STM. PRESS., PSI	115	140	140		

KVB

TEST NO.	7b	7c	7d		
CONTROLS					
Plant Master	27.5	15.0	12.0		
Forced Draft Damper	14.1	12.6	10.0		
Stoker	13.1	13.1	12.0		
Induced Draft Damper	17.2	16.3	13.2		
Feedwater Control Valve	12.0	12.7	12.8		
STOKER					
Coal Gate Position	7"/7"	7"/7"	7"/7"		
Grate Speed					
Windbox Control Position #1	45%/45%	→	60%/60%		
#2	55%/50%	→	100%/100%		
#3	10%/10%	→	100%/100%		
#4	CLOSED/CLOSED	→	→		
Overfire Air Pressure, "H_2O	3.0	3.0	3.0		
Flue Gas Temperature, °F					

TEST SITE N

KVB

NOTES

TEST NO: 7d (coal bed uneven. Large chunk in center of bed.

TEST NO:

TEST NO:

TEST NO:

TEST NO:

KVB

PANEL BOARD DATA
ABMA TEST SITE H

Steam Flow, lb/hr 33,666
Coal Flow, lb/hr 2420
Lb/Steam/Lb Coal 13.9

TEST NO.	8	8	8		
TEST DATE	3-29-79	3-29-79	3-29-79		
TEST COAL	SANDS HILL				
TEST CONDITIONS:	75% LOAD				
	NORM O_2 NORM DEA				
	PARTIC.				
COAL SCALE					
Start & stop time	08:30/10:30				
Pounds Coal Added	4840				
STEAM INTEGRATOR					
Reading	591466	591507	591577		
Time of Reading	09:40	09:24	10:42		
CHART RECORDER					
Steam Flow, lb/hr	34000	33000	34000		
Air Flow, Relative	21.0	21.0	20.9		
DRAFT GAUGES					
Furnace Draft, "H_2O	-0.2	-0.2	-0.2		
Boiler Outlet Draft, "H_2O	-0.6	-0.6	-0.6		
Compartment #1 Draft, "H_2O	0.0	0.0	0.0		
#2 Draft, "H_2O	+0.3	+0.3	+0.3		
#3 Draft, "H_2O	+0.1	+0.1	+0.1		
#4 Draft, "H_2O	0.0	0.0	0.0		
STM. PRESS, PSI	135	132	140		

KVB

TEST NO.	8	8	8		
CONTROLS					
Plant Master	25.7	27.2	13.2		
Forced Draft Damper	10.2	10.2	10.2		
Stoker	11.7	11.7	11.7		
Induced Draft Damper	13.7	13.5	13.5		
Feedwater Control Valve	13.0	12.9	13.0		
STOKER					
Coal Gate Position (L/R)	7"/7"	7"/7"	7"/7"		
Grate Speed					
Windbox Control Position #1	50%/50%	→	→		
(L/R) #2	100%/100%	→	50%/50%		
#3	25%/25%	→	→		
#4	CLOSED/CLOSED	→	→		
Overfire Air Pressure, "H_2O	3.0	2.9	2.9		
Flue Gas Temperature, °F					

TEST SITE N

KVB

PANEL BOARD DATA
ABMA TEST SITE H

Steam Flow, lb/hr 23,333
Coal Flow, lb/hr 2704
Lb/Steam/Lb Coal 8.6

TEST NO.	9	9	9		
TEST DATE	3-30-79	3-30-79	3-30-79		
TEST COAL	SANDS HILL COAL	→	→		
TEST CONDITIONS:	50% LOAD	→	→		
	NORM O_2 NORM OFA	→	→		
	PARTIC	→	→		
COAL SCALE					
Start & stop time	08:03 / 10:39				
Pounds Coal Added	6895				
STEAM INTEGRATOR					
Reading	592013	592070	592120		
Time of Reading	08:12	09:43	11:02		
CHART RECORDER					
Steam Flow, lb/hr	24,000	23,000	23,000		
Air Flow, Relative	21.2	19.1	19.0		
DRAFT GAUGES					
Furnace Draft, "H_2O	-0.2	-0.2	-0.2		
Boiler Outlet Draft, "H_2O	-0.6	-0.6	-0.6		
Compartment #1 Draft, "H_2O	+0.1	0.0	+0.05		
#2 Draft, "H_2O	+0.3	+0.3	+0.3		
#3 Draft, "H_2O	+0.2	+0.3	+0.2		
#4 Draft, "H_2O	0.0	0.0	0.0		
STM. PRESS. PSI	120	117	138		

KVB

TEST NO.	9	9	9		
CONTROLS					
Plant Master	27.5	27.5	19.0		
Forced Draft Damper	10.1	10.1	10.1		
Stoker	10.0	10.0	10.0		
Induced Draft Damper	14.2	13.6	13.5		
Feedwater Control Valve	10.5	10.0	8.1		
STOKER					
Coal Gate Position (L/R)	6"/6"	6"/6"	6"/6"		
Grate Speed					
Windbox Control Position #1	60%/60%	35%/35%	→		
(L/R) #2	100%/100%	60%/35%	35%/25%		
#3	30%/30%	45%/25%	30%/25%		
#4	CLOSED/CLOSED	CLOSED/CLOSED	→		
Overfire Air Pressure, "H_2O	3.0	3.0	3.0		
Flue Gas Temperature, °F	335	340	340		

TEST SITE #1

KVB

PANEL BOARD DATA
ABMA TEST SITE H

Steam Flow, lb/hr 22,875
Coal Flow, lb/hr 2381
Lb/Steam/Lb Coal 9.6

TEST NO.	10a&b	10c	10d	10e	
TEST DATE	3-30-79	3-30-79	3-30-79	3-30-79	
TEST COAL	SANDS HILL	→	→	→	
TEST CONDITIONS:	NORM OFA	→	→	→	
	50% LOAD	→	→	→	
	VARY O_2	→	→	→	
	BASELINE MED -HI O_2	LO O_2	MED-LO O_2	HI O_2	
COAL SCALE					
Start & stop time	11:15 / 13:36				
Pounds Coal Added	5595				
STEAM INTEGRATOR					
Reading	592134	592179	592187	592224	
Time of Reading	11:26	12:37	12:51	13:45	
CHART RECORDER					
Steam Flow, lb/hr	22,500	25,000	23,000	21,000	
Air Flow, Relative	19.0	17.5	17.5	20.6	
DRAFT GAUGES					
Furnace Draft, "H_2O	-0.2	-0.2	-0.2	-0.2	
Boiler Outlet Draft, "H_2O	-0.6	-0.5	-0.5	-0.7	
Compartment #1 Draft, "H_2O	0.0	+0.3	+0.3	+1.0	
#2 Draft, "H_2O	+0.3	+0.5	+0.4	+1.1	
#3 Draft, "H_2O	+0.3	0.0	0.0	0.0	
#4 Draft, "H_2O	+0.0	0.0	0.0	0.0	
STM PRESS. PSI	131	138	139	135	

KVB

TEST NO.	10a	10b	10c	10d	
CONTROLS					
Plant Master	27.5	18.0	17.8	21.0	
Forced Draft Damper	10.1	9.0	9.0	13.1	
Stoker	10.0	10.0	10.0	10.0	
Induced Draft Damper	13.5	13.3	17.6	15.8	
Feedwater Control Valve	8.2	9.1	8.3	8.0	
STOKER					
Coal Gate Position (L/R)	6" / 6"	6" / 6"	6" / 6"	6" / 6"	
Grate Speed					
Windbox Control Position #1	30% / 35%	55% / 55%	—	→	
#2	100% / 100%	—	—	→	
#3	CLOSED / 20%	CLOSED / CLOSED	—	→	
#4	CLOSED / CLOSED	—	—	→	
Overfire Air Pressure, "H_2O	2.9	2.9	2.9	2.9	
Flue Gas Temperature, °F					

TEST SITE H

KVB

PANEL BOARD DATA
ABMA TEST SITE H

Steam Flow, lb/hr 45000
Coal Flow, lb/hr 5050/5548 Avg.= 5299
Lb/Steam/Lb Coal 8.5

TEST NO.	11	11	11	11	
TEST DATE	4-4-79	4-4-79	4-4-79	4-4-79	
TEST COAL	SANDS HILL	→	→	→	
TEST CONDITIONS:	MIN O_2	→	→		
	NORM OFA	→	→	→	
	SASS F				
	GOKSOYR-ROSS				
COAL SCALE					
Start & stop time	10:00/11:00	11:10/12:33			
Pounds Coal Added	5050	7675			
STEAM INTEGRATOR					
Reading	593743	593931	594099	594250	
Time of Reading	09:05	11:29	13:35	15:29	
CHART RECORDER					
Steam Flow, lb/hr	43000	46000	45000	46000	
Air Flow, Relative	36.0	36.0	36.2	36.5	
DRAFT GAUGES					
Furnace Draft, "H_2O	-0.2	-0.2	-0.2	-0.2	
Boiler Outlet Draft, "H_2O	-1.1	-1.1	-1.1	-1.1	
Compartment #1 Draft, "H_2O	+0.7	+0.7	+0.65	+0.6	
#2 Draft, "H_2O	+1.2	+1.1	+1.1	+1.1	
#3 Draft, "H_2O	+1.0	+1.0	+1.0	+1.0	
#4 Draft, "H_2O	0.0	0.0	0.0	0.0	
SIM PRESS, PSI	132	134	127	140	

KVB

TEST NO.	11	11	11	11	
CONTROLS					
Plant Master	27.4	26.0	27.5	16.0	
Forced Draft Damper	13.5	13.5	13.5	13.5	
Stoker	12.0	12.0	12.0	12.0	
Induced Draft Damper	18.7	18.8	18.2	18.6	
Feedwater Control Valve	16.6	20.2	23.3	20.5	
STOKER					
Coal Gate Position (L/R)	9"/9"	9"/9"	9"/9"	9"/9"	
Grate Speed					
Windbox Control Position #1	50%/55%	→	→	→	
(L/R) #2	100%/100%	→	→	→	
#3	100%/100%	→	→	→	
#4	closed/closed	→	→	→	
Overfire Air Pressure, "H_2O	3.0	3.0	2.9	2.9	
Flue Gas Temperature, °F	540	→	→	→	

TEST SITE N

SECTION 2.0

PARTICULATE DATA

		PAGE
2.1	PARTICULATE DATA SUMMARY	35
2.2	PARTICULATE DATA SHEETS	37
2.3	PARTICULATE LAB WORKSHEET	42

STACK AREA = 19.635 ft²

PARTICULATE DATA SUMMARY
PART I

LOCATION: ASMA TEST SITE H

TEST NO.	Total Mass mgm.	Dry Gas Volume ft^3	Liquid Coll. ml.	Baro. Press. "Hg	Static Press. "H_2O	Pitot ΔP "H_2O	Orifice ΔH "H_2O	Stack Gas Temp. °R	Excess O_2 %	Sampling Time min.	Nozzle Dia. in.	Pitot Factor n.d.	Fuel Factor SCF/10^6BTU	Flue Gas MW g/g mole
03	4421.8	63.675	88.6	29.36	-.245	0.143	0.921	969	5.0	96	0.375	.837	8716	29.29
05	975.2	31.770	49.1	29.22	-.28	.117/.183	.85/.28	893	9.4	24/48	.375/.25	.837	9005	27.02
06	688.3	33.70	45.0	29.52	-.41	0.183	0.284	885	10.6	96	.250	.837	9715	29.17
08	476.4	29.65	51.9	29.31	-.20	0.038	0340	841	8.2	79	.375	.837	9186	29.04
09	664.1	43.59	77.0	29.38	-.18	0.034	0.818	795	11.6	72	.500	.837	8906	28.73

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PARTICULATE DATA SUMMARY
PART II

Location ABMA TEST SITE 4

TEST NO.	LOAD %	O_2 %	CONDITIONS	Corrected ↓	EMISSIONS lb/10^6BTU	EMISSIONS GR/SCF	EMISSIONS LB/HR	Moisture %	Stack Gas Velocity Ft/sec	Stack Gas Flow SCF/sec	Isokin. %
03	101.6	8.0	min O_2 low OFA	2.195	2.473	1.090	170	6.28	28.73	303	98
05	99.0	9.4	low O_2 high OFA	1.130	1.233	0.485	84	6.97	29.47	335	98
06	97.3	10.6	high O_2 high OFA	0.897	0.907	0.319	59	6.02	31.04	360	99
08	74.8	8.2	normal O_2 and OFA	0.545	0.583	0.253	22	7.80	13.87	168	101
09	51.9	11.6	normal O_2 and OFA	0.681	0.751	0.239	20	7.84	12.81	165	94

#15900 Rev.

PARTICULATE

DATA

Leak Check Rate — Vac in. Hg — ft^3/min — Before — After

ISOKINETICS = 98.5%

Sampling Time Per Point, Min
4

TEST NUMBER 3
DATE 3-22-74
OPERATOR
FUEL S.H.
SITE H
PROBE LOCATION Stack

Sample Point	Time	METER CONDITIONS			TEMPERATURES, °F						O_2, %	Vac.
		ΔP_s	ΔH	Meter Reading	Stack	Probe	Oven	Impingers In	Impingers Out	Meter		
Equip. Check												
1	4 min	.08	.53	414.33	510	300	270	165	60	65		2.5
2		.09	.70	416.46	509	310	275	165	60	70		3.0
3		.095	.63	418.59	508	350	343	170	62	70		3.0
4		.095	.63	420.80	509	350	343	180	62	70		3.0
5		.035	.50	422.50	509			175	62	72		2.5
6		.085	.57	424.185	509			175	62	73		2.7
7		.13	.87	426.77	509			155	63	74		3.3
8		.165	1.05	429.57	509			155	63	74		4.0
9		.19	1.22	432.55	509			170	64	74		4.2
10		.195	1.24	436.30	509			175	64	74		4.2
11		.195	1.24	439.35	509			180	62	76		
12		.14	.8	441.485	509			195	62	76		
Meter Check		.16	1.02	444.79	509	350	343	145	66	73		4.5
2		.165	1.05	447.612	511			170	66	75		4.5
3		.17	1.09	450.58	518			170	66	75		5.0
4		.18	1.15	453.50	520			175	66	78		5.2
5		.175	1.12	456.41	522			165	70	78		5.2
6		.16	1.02	459.20	520			165	70	78		5.0
7		.175	1.12	462.16	522			165	70	78		5.2
8		.175	1.12	465.03	520			185	68	78		5.2
9		.155	.97	467.72	520			140	68	75		4.8
10		.15	.96	470.50	520			185	70	78		
11		.135	.87	473.04	520			185	70	78		
12	V	.10	.64	475.325	520			185	70	78		
	96											
Average		0.143	0.92		509°F 469°R					75°F		

METER VOL. END 475.325
START 411.05
SAMPLE VOL 63.275 ft^3

C_{pitot}	Stack Press. In. Hg-Gauge	Barometric Pressure
	-.2415	29.32

Percent O_2 = 8.0

Nomograph Setup

P_{meter} = C =
P_{stack} = T_{stack} =
T_{meter} = ΔP =
ΔH_g = Noz(Ideal)=
% H_2O = 6.3 Noz(Actual)=

Imp.	Vol.(End)	Vol. (Start)	ΔVol.(ml)
#1	165	100	65
#2	109	100	9
#3	1	0	1
		Total	75

#4	g(End)	g(Start)	Δgrams
Silica Gel	1636	1500	136
		Total Vol. H_2O	88.6 ml

PARTICULATE

DATA

Leak Check Rate — Vac in. Hg — ft^3/min

ISOKINETICS = 105.2%

Sampling Time Per Point, Min	
3	Before
	After

TEST NUMBER 45
DATE 3 24 77
OPERATOR
FUEL Sand Oil
SITE H
PROBE LOCATION Stack

Sample Point	Time	METER CONDITIONS ΔP_s	ΔH	Meter Reading	TEMPERATURES, °F Stack	Probe	Oven	Impingers In	Impingers Out	Meter	O_2, %	Vac.
Equal 1	3min	.07	.46	477.23	435	235	175	120	35	35		2.0
2		.075	.49	477.08	435	235	200	120	35	35		2.0
3		.085	.55	480.56	435	235	205	125	35	35		3.1
4		.065	.55	482.18	435	240	205	125	35	35		3.0
5		.10	.77	484.00	435	240	210	125	35	35		3.1
6		.115	.88	485.66	435	240	210	130	35	35		3.2
7		.17	1.32	488.21	435	240	210	150	35	40		5.0
8 (0.375 in 22 pts)		.225	1.78	490.97	435	240	230	150	35	40		5.0
9		.325	.50	492.41	420	235	240	135	35	35		2.2
10 (0.25 in 16 pts)		.33	.51	493.83	420	240	235	140	35	35		2.0
11		.315	.48	495.31	435	235	235	155	35	35		2.1
12		.205	.31	496.33	435	240	235	140	35	35		2.0
13		.10	.153	497.03	425	230	245	120	32	35		1.0
14		.115	.165	497.83	430	230	245	120	32	35		1.4
15		.19	.30	499.65	430	240	240	135	32	35		1.5
16		.15	.225	499.47	430	255	230	150	32	40		1.5
17		.17	.260	501.00	430	255	235	145	32	40		2.0
18		.175	.27	502.10	430	240	230	145	32	40		2.0
19		.18	.28	503.40	430	235	225	145	30	38		2.0
20		.16	.241	504.36	430	235	230	145	30	38		2.0
21		.15	.235	505.30	430	235	240	150	30	38		1.5
22		.14	.215	506.20	430	235	240	145	30	40		1.5
23		.13	.20	507.02	430	235	240	140	30	40		1.5
24	↓	.09	.141	507.45	430	235	240	135	30	42		1.0
Average												

METER VOL. END
START
SAMPLE VOL ft³

C_{pitot}	Stack Press. In. Hg-Gauge	Barometric Pressure
.837	-0.25	29.22

Percent O_2 = 9.4

Nomograph Setup

P_{meter} = C =
P_{stack} = T_{stack} =
T_{meter} = ΔP =
ΔH_g = Noz(Ideal)=
% H_2O = 7.0 Noz(Actual)=

Imp.	Vol.(End)	Vol. (Start)	ΔVol.(ml)
#1	130	100	30
#2	107	100	7
#3	6	0	6
		Total	43

#4	g(End)	g(Start)	Δgrams
Silica Gel	1564	1543	21
		Total Vol. H_2O	64 ml

Avg for 1st 8 pts ΔP_s = 0.117 ΔH = 0.850 Vol = 14.34

Avg for last 16 pts ΔP_s = 0.183 ΔH = 0.280 Vol = 14.98

PARTICULATE

DATA

Leak Check Rate — Vac in. Hg — ft^3/min

ISOKINETICS = 104.5 %

Sampling Time Per Point, Min
4

Before

After

TEST NUMBER

DATE 7-27-22

OPERATOR

FUEL Sawdust Pellets

SITE 14

PROBE LOCATION Stack

Sample Point	Time	METER CONDITIONS			TEMPERATURES, °F						O_2, %	Vac.
		ΔP_s	ΔH	Meter Reading	Stack	Probe	Oven	Impingers In	Impingers Out	Meter		
Traverse 1	4min	.175	.27	510.53	425	250	180	80	30	30		1.2
2		.175	.27	511.76	425	250	180	85	30	35		1.2
3		.185	.284	513.19	425	260	195	92	30	35		1.5
4		.195	.31	514.61	425	265	205	92	30	35		1.8
5		.21	.33	516.13	425	270	215	115	30	35		1.8
6		.22	.34	517.68	425	270	215	115	30	35		1.9
7		.21	.33	519.27	425	265	215	112	30	40		1.5
8		.18	.28	520.68	425	265	215	115	30	40		1.8
9		.16	.25	521.98	425	260	220	115	30	40		1.6
10		.15	.23	523.31	425	260	225	115	30	40		1.5
11		.13	.20	524.38	425	260	225	110	30	40		1.0
12		.08	.125	525.05	425	250	230	105	30	40		1.0
13		.20	.31	526.87	425	230	240	105	30	40		1.6
14		.22	.34	528.40	425	240	240	130	30	40		1.7
15		.25	.39	530.10	425	260	240	150	30	40		2.0
16		.265	.42	531.78	425	260	245	155	30	40		2.1
17		.28	.44	533.56	425	265	250	160	30	40		2.1
18		.24	.37	535.21	425	268	260	168	30	40		1.8
19		.19	.30	536.60	425	260	265	160	30	40		1.6
20		.17	.26	538.00	425	260	265	150	30	45		1.5
21		.15	.23	539.44	425	250	265	145	30	45		1.4
22		.13	.20	540.58	425	250	265	140	30	45		1.3
23		.13	.20	541.70	425	250	265	140	30	45		1.3
24		.09	.14	542.70		250	265	140	30	45		
Average		0.183	0.284		425F					40F		

METER VOL. END 542.70

START 509.02

SAMPLE VOL. 33.7 ft^3

C_{pitot}	Stack Press. In. Hg-Gauge	Barometric Pressure
0.837	-.41	29.52

Percent O_2 =

Nomograph Setup

P_{meter} = C =

P_{stack} = T_{stack} =

T_{meter} = ΔP =

ΔH_g = Noz(Ideal)=

% H_2O = 6.0 Noz(Actual)=

Imp.	Vol.(End)	Vol. (Start)	ΔVol.(ml)
#1	129	100	29
#2	108	100	8
#3	2	0	2
		Total	39

#4	g(End)	g(Start)	Δgrams
Silica Gel	160.3	154.3	6.0
		Total Vol. H_2O	45 c ml

PARTICULATE

DATA

Leak Check Rate — Vac in. Hg / ft³/min

ISOKINETICS = 103%

TEST NUMBER 8
DATE 3-29-79
OPERATOR
FUEL Sunoco 14.11
SITE 14
PROBE LOCATION Stack

Sampling Time Per Point, Min	
3	Before
	After

Sample Point	Time	METER CONDITIONS ΔPs	ΔH	Meter Reading	TEMPERATURES, °F Stack	Probe	Oven	Impingers In	Impingers Out	Heter	O_2, %	Vac.
Pos Ref	—	.00	—	540.07	—	—	—	—	—	—	—	
1 & 2	3 m	.02	.12	541.62	340	210	160	80	60	55		1.0
3	3 m	.03	.18	546.48	370	250	180	100	60	60		1.5
4	3 m	.035	.25	547.43	390	250	190	100	60	60		2.0
5	3 m	.04	.30	548.48	390	260	190	110	60	63		2.0
6	3 m	.035	.26	549.43	400	260	200	125	60	65		2.0
7 & 8	4 min	.04	.30	551.20	390	260	200	110	60	65		3.0
8	1	.025	.18	552.11	390	260	200	120	60	68		2.0
9	1	.025	.18	553.04	390	250	200	125	55	65		2.0
10		.01	—	—	—	—	—	—	—	—	—	
11		.015	.11	553.89	350	230	180	120	55	55		1.0
12		—	—	—	—	—	—	—	—	—	—	—
13 & Pitot		.02	.15	554.82	390	260	200	90	65	60		—
14		.025	.20	556.05	380	240	180	100	50	60		2.0
15		.03	.241	557.36	360	250	190	110	50	60		2.0
16		.035	.29	558.65	350	230	190	100	50	60		2.0
17		.04	.32	560.24	350	270	160	100	50	63		3.0
18		.05	.40	561.89	375	260	200	100	50	63		5.0
19		.09	.72	564.22	350	260	200	110	50	65		4.0
20		.09	.72	566.49	370	260	200	125	50	65		4.0
21		.085	.69	568.42	370	260	200	120	50	67		4.0
22		.08	.64	571.10	370	270	210	130	50	67		4.0
23		.07	.56	573.14	350	270	210	140	50	67		3.0
24	1	.04	.32	574.72	—	270	220	140	55	72		2.0
	74											
Average		0.038	0.30		371.6					63.6		

METER VOL. END 574.72
START 540.07
SAMPLE VOL. 34.65 ft³

C_{pitot}	Stack Press. In. Hg-Gauge	Barometric Pressure
.83		29.3

Percent O_2 = 9.2

Nomograph Setup

P_{meter} = C =
P_{stack} = T_{stack} =
T_{meter} = ΔP =
ΔH_g = Noz(Ideal)=
% H_2O = 7 % Noz(Actual)=

Imp.	Vol.(End)	Vol. (Start)	ΔVol.(ml)
#1	135	100	35
#2	142	140	2
#3	5	0	5
		Total	42

	g(End)	g(Start)	Δgrams
#4 Silica Gel	154.9	150.0	4.9
		Total Vol. H_2O	51.4 ml

PARTICULATE

DATA

Leak Check Rate — Vac in. Hg — ft^3/min —

ISOKINETICS = 97.7 %

Sampling Time Per Point, Min
3

Before

After

TEST NUMBER 9
DATE 3-30-79
OPERATOR
FUEL Sands 1+11
SITE H
PROBE LOCATION Stack E

Sample Point	Time	METER CONDITIONS			TEMPERATURES, °F						O_2, %	Vac.
		ΔP_s	ΔH	Meter Reading	Stack	Probe	Oven	Impingers In	Impingers Out	Meter		
Equipment 1	3m	.02	.48	576.10	335	265	210	110	45	55		3.0
2		.03	.73	577.35	335	270	210	120	45	55		3.8
3		.04	.97	579.85	335	270	230	150	45	55		5.0
4		.05	1.21	582.12	340	280	250	170	45	55		6.0
5		.05	1.21	584.37	345	280	240	170	45	55		6.0
6		.055	1.33	586.67		285	250	170	45	55		6.0
7		.05	1.21	589.65		285	255	170	45	55		6.0
8		.05	1.21	592.44		285	270	170	45	55		6.0
9		.04	.97	593.95		295	280	175	45	55		4.2
10		.03	.73	595.7		295	280	175	45	55		3.8
11		.025	.60	597.35		270	290	190	215	58		3.0
12		.015	.36	598.50		275	290	195	45	58		2.0
Equipment 1		.01	.221	599.67		240	275	130	48	58		1.3
2		.01	.271	600.61		245	275	132	118	58		1.3
3		.01	221	601.52		245	275	150	118	58		1.3
4		.01	.221	602.46		250	280	155	48	55		1.3
5		.015	.36	603.60		250	280	160	48	58		2.0
6		.025	.60	605.24				170	48	55		3.7
7		.05	1.21	607.51						58		6.0
8		.055	1.33	609.97						58		6.1
9		.06	1.45	612.5		270	285	190	48	60		7.0
10		.05	1.21	614.74						60		
11		.04	.97	616.36						60		
12	✓	.025	.60	618.31	✓					60		
	72											
Average		0.034	0.819		335					57.5		

METER VOL. — END 618.31 — START 574.73 — SAMPLE VOL. 43.58 ft^3

C_{pitot}	Stack Press. In. Hg-Gauge	Barometric Pressure
.537	-.15	29.34

Percent O_2 = 11.6

Nomograph Setup

P_{meter} = C =
P_{stack} = T_{stack} =
T_{meter} = ΔP =
ΔH_g = Noz(Ideal)=
% H_2O = 7.8 Noz(Actual)=

Imp.	Vol.(End)	Vol. (Start)	ΔVol.(ml)
#1	142	138	4
#2	127	120	7
#3	0	0	0
		Total	411

#4 Silica Gel	g(End)	g(Start)	Δgrams
	150.0	150.0	3.0
		Total Vol. H_2O	77.0 ml

PARTICULATE LAB WORKSHEET

TEST NO. 3 (Inlet, Outlet) LOCATION H

Date 3/[illegible] Box No. _____ Eng. _____

Test Description _____

Dry Gas Meter Vol (ft^3)

Final _____

Initial _____

Δ DgV _____

Impinger Water Vol (ml)

	1	2	3	Total
Final				
Initial	100[illegible]	[illegible]2	0	
Δ Vlc				

CONTENT		H_2O RINSE	ACETONE RINSE	DRY FLASK	FILTER NO.	BLANK NO.	
BOTTLE NO.							
BEAKER NO.			2	4	#2		
DATE WT.			3/[illegible]	[illegible]	3/2[illegible]		
TARE WT.	1		100.6057	100.79[illegible]	.76[illegible]		
	2		100.6059	100.7920	.7644		
	3		100.6[illegible]	100.[illegible]19	.7641		
	4						
AVG.			100.6058	100.7[illegible]4	.7642		

POST TEST WTS.

1		[illegible]	[illegible]	[illegible]		
2		[illegible]	[illegible]	[illegible]		
3		[illegible]	[illegible]	[illegible]		
4						
AVG.		[illegible].9557	[illegible]4.6[illegible]4	.9516		
Δ WT.		.3494	3.8945	.1874		

Δ Vlc = _____ ml LOAD _____ klb/hr

Δ DgV = _____ ft^3 O_2 _____ %

Δ Mn 4421.8 mgm REMARKS: _____

8830-5 rev.

PARTICULATE LAB WORKSHEET

TEST NO. 5 (Inlet, Outlet) LOCATION SITE H

Date 3/26/79 Box No. _____ Eng. _____

Test Description MIN O_2, HIGH OFA

Dry Gas Meter Vol (ft^3)

Final _____

Initial _____

Δ DgV _____

Impinger Water Vol (ml)

	1	2	3	Total
Final				
Initial				
Δ Vlc				

CONTENT		H_2O RINSE	ACETONE RINSE	DRY FLASK	FILTER NO.	BLANK NO.	
BOTTLE NO.							
BEAKER NO.			#8	#5	#3		
DATE WT.			3/20/79	3/20/79	3/20/79		
TARE WT.	1		99.3337	99.9256	.7585		
	2		99.3341	99.9257	.7588		
	3		99.3340	99.9258	.7586		
	4						
AVG.			99.3339	99.9257	.7586		

POST TEST WTS.

1		99.4510	100.7210	.8218		
2		99.4528	100.7203	.8214		
3		99.4506	100.7204	.8220		
4		99.4504	100.7198			
AVG.		99.4512	100.7204	.8217		
Δ WT.		.1173	.7947	.0632		

Δ Vlc = _____ ml

Δ DgV = _____ ft^3

Δ Mn 975.2 mgm

LOAD _____ klb/hr

O_2 _____ %

REMARKS: _____

8830-5 rev.

PARTICULATE LAB WORKSHEET

TEST NO. 6 (Inlet, Outlet) LOCATION SITE H

Date 3/27/79 Box No. _____ Eng. _____

Test Description HIGH O_2, HIGH OFA

Dry Gas Meter Vol (ft^3)

Final _____

Initial _____

Δ DgV _____

Impinger Water Vol (ml)

	1	2	3	Total
Final				
Initial				
Δ Vlc				

CONTENT		H_2O RINSE	ACETONE RINSE	DRY FLASK	FILTER NO.	BLANK NO.	
BOTTLE NO.							
BEAKER NO.			#10	#11	#4		
DATE WT.			3/20/79	3/20/79	3/20/79		
TARE WT.	1		100.9350	99.8079	.7619		
	2		100.9351	99.8083	.7617		
	3		100.9352	99.8083	.7618		
	4		—	—	—		
AVG.			100.9351	99.8081	.7618		

POST TEST WTS.

1		101.4588	99.9893	.8214		
2		101.4585	99.9886	.8215		
3		101.4505	99.9888	.8213		
4						
AVG.		101.4559	99.9889	.8214		
Δ WT.		.5208	.1079	.0596		

Δ Vlc = _____ ml

Δ DgV = _____ ft^3

Δ Mn 688.3 mgm

LOAD _____ klb/hr

O_2 _____ %

REMARKS: _____

8830-5 rev.

PARTICULATE LAB WORKSHEET

TEST NO. 8 (Inlet, Outlet) LOCATION ABMA SITE H

Date 3/29/79 Box No. _____ Eng. Tidona

Test Description 75% LOAD, NORMAL O_2 & OFA

Dry Gas Meter Vol (ft^3)

Final _____

Initial _____

Δ DgV _____

Impinger Water Vol (ml)

	1	2	3	Total
Final				
Initial				
Δ Vlc				

CONTENT		H_2O RINSE	ACETONE RINSE	DRY FLASK	FILTER NO.	BLANK NO.	
BOTTLE NO.							
BEAKER NO.			12	15	5		
DATE WT.			3/20/79	3/20/79	3/20/79		
TARE WT.	1		100.9680	101.4094	.7681		
	2		100.9678	101.4096	.7680		
	3		100.9679	101.4097	.7681		
	4						
AVG.			100.9679	101.4096	.7681		

POST TEST WTS.

1		101.0797	101.6676	.8745		
2		101.0802	101.6672	.8750		
3		101.0799	101.6669	.8752		
4						
AVG.		101.0799	101.6672	0.8749		
Δ WT.		0.1120	0.2576	0.1068		

Δ Vlc = _____ ml

Δ DgV = _____ ft^3

Δ Mn 476.4 mgm

LOAD _____ klb/hr

O_2 _____ %

REMARKS: _____

8830-5 rev.

PARTICULATE LAB WORKSHEET

TEST NO. 9 (Inlet, Outlet) LOCATION SITE H

Date 3/30/79 Box No. _____ Eng. _____

Test Description 50% LOAD, NORMAL O_2 & OFA

Dry Gas Meter Vol (ft^3)

Final _____

Initial _____

Δ DgV _____

Impinger Water Vol (ml)

	1	2	3	Total
Final				
Initial				
Δ Vlc				

CONTENT		H_2O RINSE	ACETONE RINSE	DRY FLASK	FILTER NO.	BLANK NO.	
BOTTLE NO.							
BEAKER NO.			31	30	829		
DATE WT.			3/20/79	3/20/79	3/20/79		
TARE WT.	1		103.9747	103.109	.7615		
	2		103.9751	103.1095	.7618		
	3		103.9752	103.1094	.7620		
	4						
AVG.			103.9750	103.1093	.7618		
POST TEST WTS.							
	1		104.0496	103.6868	.7739		
	2		104.0494	103.6866	.7741		
	3		104.0492	103.6863	.7746		
	4						
AVG.			104.0494	103.6866	0.7742		
Δ WT.			0.0744	0.5773	0.0124		

Δ Vlc = _____ ml

Δ DgV = _____ ft^3

Δ Mn 664.1 mgm

LOAD _____ klb/hr

O_2 _____ %

REMARKS: _____

8830-5 rev.

SECTION 3.0

GASEOUS DATA

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GASEOUS EMISSION SUMMARY

Location: TEST SITE #

Fuel: SANDS HILL COAL

TEST NO.	DATE	LOAD %	CONDITIONS	Boiler Outlet O_2 % Dry	Boiler Outlet CO_2 % Dry	Boiler Outlet CO ppm Dry	Boiler Outlet NO ppm Dry	Boiler Outlet NO_2 ppm Wet	Boiler Outlet HC ppm Wet	O_2 % Dry	CO_2 % Dry	CO ppm Dry	NO ppm Dry	SO_2 ppm Dry	SO_3 ppm Dry	NOTES
01A	03-19-79	87.8	VARY O_2, NORM OFA	9.2	9.2	153	305									
01B	03-19-79	87.8	↓	10.5	7.6	239	360									
02A	03-20-79	96.0	VARY O_2, NORM OFA	7.2	11.0	163	270	0						1565		
02B	03-20-79	96.0	↓	8.4	9.6	96	275	0						1254		
02C	03-20-79	96.0		10.3	7.9	274	367	0						1473		
02D	03-20-79	96.0		9.3	8.9	196	276	4						1692		
02E	03-20-79	96.0		8.8	8.8	162	312	0						1918		
02F	03-20-79	96.0	↓	7.7	9.1	712	226	0						1618		
03	03-22-79	100.0	MIN O_2, LOW OFA	8.0	10.8	513	274	13						1359		
04	03-23-79	49.9	VARY OFA	9.8	8.4	41	279									
05	03-26-79	99.0	LOW O_2, HIGH OFA	9.4	9.2	41	339	1	5					1830		
06	03-27-79	97.3	HIGH O_2, HIGH OFA	10.6	9.1	69	331	9	35					1754		
07A	03-28-79	75.5	VARY O_2, LOW OFA	8.2	10.3	56	207	1	29					2631		
07B	03-28-79	75.5	↓	12.8	5.7	340	344	10	132					3821		
07C	03-28-79	75.5		10.1	9.4	99	314	2	99					3315		
07D	03-28-79	75.5	↓	5.3	13.2	665	161	0	64					2300		

NOTE: All parts per million (ppm) figures are corrected to a 3% O_2 constant dilution factor

#15900

GASEOUS EMISSION SUMMARY

Location: TEST SITE #

Fuel: SANDS HILL COAL

TEST NO.	DATE	LOAD %	CONDITIONS	BOILER OUTLET O_2 % Dry	CO_2 % Dry	CO ppm Dry	NO ppm Dry	NO_2 ppm Wet	HC ppm Wet	O_2 % Dry	CO_2 % Dry	CO ppm Dry	NO ppm Dry	SO_2 ppm Dry	SO_3 ppm Dry	NOTES
08	03-29-79	74.8	NORM O_2 & OFA	8.2	10.3	76	196	0	68					2357		
09	03-30-79	51.9	NORM O_2 & OFA	11.6	7.3	148	244	1	94					1958		
10A	03-30-79	50.8	VARY O_2, NORM OFA	11.5	7.4	95	247	9	133					1828		
10B	03-30-79	50.8	↓	12.8	5.7	265	265	0	113					1613		
10C	03-30-79	50.8	↓	9.2	9.2	63	245	0	76					1668		
10D	03-30-79	50.8	↓	10.4	8.6	85	252	7	82					1773		
10E	03-30-79	50.8	↓	13.7	5.8	443	286	0	127					1740		
11	04-04-79	100.0	MIN O_2, NORM OFA	9.4	9.2	197	353	0	112					1765		

NOTE: All parts per million (ppm) figures are corrected to a 3% O_2 constant dilution factor

#15900

REV.

KVB

C

GASEOUS EMISSIONS DATA

TEST SITE H

TEST NO. 1 A×8

DATE 3-19-79

FUEL SANDS HILL COAL

LOAD

CONDITIONS VARY O_2, GASEOUS EMISSIONS

DATA TAKEN BY NORM. OFA

PORT 1 = PORT C

Probe Position	Time	O_2 % (dry)	CO_2 % (dry)	CO ppm(dry) unc	CO ppm(dry) cor	NO ppm(dry) unc	NO ppm(dry) cor	HOT LINE SAMPLES, PPM(WET) NOx unc	NOx cor	NO unc	NO cor	NO2 unc	NO2 cor	HC unc	HC cor	Remarks
PORT H				readings not available from hot line												Hot line bad
PORT 1	10:36	9.2	9.2	100	153	200	305									BASELINE (HIGH O_2)
PORT 1	1320	10.5	7.6	140	239	210	360									BASELINE (HIGH O_2)
	AVG.	9.9	8.4		196		333									
	AVG.															
	AVG.															

C

NOTE: Parts per million (ppm) figures are corrected to 3% O_2

15900

KVB

C

GASEOUS EMISSIONS DATA

TEST SITE H
TEST NO. #2
DATE 3/20/79

FUEL Sandsh. II
LOAD 100%
CONDITIONS Vest O_2, NORM OFA
DATA TAKEN BY JEC

Probe Position	Time	O_2 % (dry)	CO_2 % (dry)	CO ppm(dry) unc	CO ppm(dry) cor	NO ppm(dry) unc	NO ppm(dry) cor	HOT LINE SAMPLES, PPM(WET) NOx unc	NOx cor	NO unc	NO cor	NO_2 unc	NO_2 cor	~~HC~~ SO_2 unc	~~HC~~ SO_2 cor	Remarks Test 2A
C	9:15	7.1	11.3	40	52	215	278			Min O_2						Hot line Cont
H	9:30	7.2	10.6	210	274	200	261	175	228	175	228	0	0	1200	1565	for #C 2-B
~~C~~	~~13:20~~	~~8.7~~	~~11.3~~													
~~H~~																
C	13:30	7.3	12.5	80	105	210	276									
H																Difficulty
	3/21/79		Test # 2B													Cont SO2
C	8:25	8.4	9.1	70	100	191	267									Inst TC
H	8:45	8.8	9.5	70	103	180	266	190	280	165	243			850	1254	Sample Coll
C	9:00	8.1	10.2	60	84	210	293									Ignitors mud
		3/21/79		Test # 2C												cleaning
C	9:45	10.25	8	160	269	230	385									
H	9:55	10.75	7.4	170	298	215	378	197	346	197	346	0	0	880	1473	
C	10:22	9.75	8.3	160	255	212	338									
		3/21/79		Test # 2D												
C	11:12	9.3	8.9	115	177	178	274									
H	11:25	9.3	8.9	140	215	180	277	172	266	170	262	3	4	1100	1692	
		3/21/79		Test # 2E												
C	13:14	8.8	8.6	60	88	210	310							?		
H	13:20	9.8	8.9	160	236	212	313	200	295	200	295	0	0	1300	1918	
		3/21	79	Test #		2F										
C	13:45	7.3	9.8	790	1061	160	215									
H	13:55	9.1	9.5	260	363	170	237	158	220	158	220	0	0	1160	1618	
	AVG.															
	AVG.															
	AVG.															

NOTE: Parts per million (ppm) figures are corrected to 3% O_2

15900

KVB

C

GASEOUS EMISSIONS DATA

TEST SITE H
TEST NO. 3 (PARTIC.)
DATE 3-22-79

FUEL SANDS HILL BIT. COAL
LOAD 100%
CONDITIONS MIN O_2, NORM (LOW) OFA
DATA TAKEN BY Shumaker

Probe Position	Time	O_2 % (dry)	CO_2 % (dry)	CO ppm(dry) unc	CO ppm(dry) cor	NO ppm(dry) unc	NO ppm(dry) cor	HOT LINE SAMPLES, PPM(WET) NOx unc	NOx cor	NO unc	NO cor	NO2 unc	NO2 cor	HC unc	HC cor	Remarks SO_2
C	10:07	7.8	10.2	250	341	198	270									
C	10:45	8.0	11.0	350	485	190	263									
C	11:15	9.2	9.6	100	153	182	278									
C	11:45	7.4	11.0	470	627	210	280									
H	12:48	6.8	12.0	930	1176	220	278	195	247	200	253	5	6			1100/1392
H	1:22	7.7	11.6	470	636			195	264	210	284	15	20			980/1326
C	1:56	8.75	9.9	120	178											
C																
																$(SO_2)_{cor}$
	AVG.	8.0	10.8	513		274										1359
	AVG.															
	AVG.															

NOTE: Parts per million (ppm) figures are corrected to 3% O_2

15900

KVB

GASEOUS EMISSIONS DATA

TEST SITE 4

TEST NO. 4

DATE 3/22/83

FUEL SANDS HILL BIT. COAL

LOAD 50% FULL LOAD

CONDITIONS OFA TRAVERSE, VARY OFA

DATA TAKEN BY _____

Probe Position	Time	O_2 % (dry)	CO_2 % (dry)	CO ppm(dry) unc	CO ppm(dry) cor	NO ppm(dry) unc	NO ppm(dry) cor	HOT LINE SAMPLES, PPM(WET) NOx unc	NOx cor	NO unc	NO cor	NO2 unc	NO2 cor	HC unc	HC cor	Remarks
C	10:32	10.50	7.2	30	51	167	286									
C	12:13	9.1	9.6	20	30	180	272									
C																
	AVG.															
	AVG.															
	AVG.															

NOTE: Parts per million (ppm) figures are corrected to 3% O_2

15900

KVB

GASEOUS EMISSIONS DATA

TEST SITE ABMA SITE H
TEST NO. 5 (Brink & Partic)
DATE 3-26-79

FUEL SANDS HILL BIT. COAL
LOAD 100%
CONDITIONS LOW O_2, HIGH OFA
DATA TAKEN BY _____

Probe Position	Time	O_2 % (dry)	CO_2 % (dry)	CO ppm(dry) unc	CO ppm(dry) cor	NO ppm(dry) unc	NO ppm(dry) cor	HOT LINE SAMPLES, PPM(WET) NOx unc	NOx cor	NO unc	NO cor	NO_2 unc	NO_2 cor	HC unc	HC cor	Remarks SO_2
C	8:50	8.4	10.2	30	43	257	367									
H								230	327	230	327	0	0	10	14	1050/1500
C	12:02	9.3	9.2	10	15	230	354									
H	12:46	10.0	8.6	25	41	192	314	180	295	178	291	2	4	0	0	1220/1996
H	1:15	9.8	8.8	40	64	200	321	170	273	170	273	0	0	0	0	1240/1993
																$(SO_2)_{cor}$
	AVG.	9.4	9.2		41		339		299		298		1		5	1830
	AVG.															
	AVG.															

NOTE: Parts per million (ppm) figures are corrected to 3% O_2

15900

KVB

GASEOUS EMISSIONS DATA

TEST SITE H
TEST NO. 6 (PARTIC.)
DATE 3/27/79

FUEL Sandhill Coal
LOAD 100%
CONDITIONS High O2 High OFA
DATA TAKEN BY JEC

Probe Position	Time	O_2 % (dry)	CO_2 % (dry)	CO ppm(dry) unc	CO ppm(dry) cor	NO ppm(dry) unc	NO ppm(dry) cor	HOT LINE SAMPLES, PPM(WET) NOx unc	NOx cor	NO unc	NO cor	NO2 unc	NO2 cor	HC unc	HC cor	Remarks
C	8:50	10.25	8.9	40	67	190	318									
C	9:05	10.25	9.2	40	67	180	301									
																Sq Vortex
H	10:07	10.6	9.7	40	69	180	312	174	301	170	294	4	7	12	21	960/1662
H	10:30	10.8	9.2	40	71	203	353	197	347	190	335	7	12	12	21	980/1729
H	11:07	11.0	8.3	40	72	207	373	207	373	202	364	5	9	15	63	1040/1872
																(Sq Vor) Ker
	AVG.	10.6	9.1		69		331		340		331		9		35	1754
	AVG.															
	AVG.															

NOTE: Parts per million (ppm) figures are corrected to 3% O_2

15900

KVB

GASEOUS EMISSIONS DATA

TEST SITE ABMA SITE H
TEST NO. 7
DATE 3-28-79

FUEL SANDS HILL B.T. COAL
LOAD 75%
CONDITIONS VARY O_2
DATA TAKEN BY M. Gabriel

Probe Position	Time	O_2 % (dry)	CO_2 % (dry)	CO ppm(dry) unc	CO cor	NO ppm(dry) unc	NO cor	HOT LINE SAMPLES, PPM(WET) NOx unc	NOx cor	NO unc	NO cor	NO_2 unc	NO_2 cor	THC unc	THC cor	SO_2 Remarks unc / cor
Hot X	0835	7.3	10.1	160		154		140		137		3		0		~~9.6~~ /
Cold X	condition change															
7A																unc. corr.
Hot & Cold	0915	8.1	10.6	40	52.6	152	200	138	181	136	179	2	3	0	0	9.3 1860 / 2444
7A																
~~Hot~~ & Cold	0945	8.7	10.2	30	44	153	224	143	209	143	209	0	0	0	0	9.3 1900 / 2780
7A																
~~Hot~~ & Cold	1015	7.3	11.4	80	105	150	197	133	175	130	171	3	4	30	39	9.6 1920 / 2523
~~7A~~ 7B	condition change	7.9	10.2	25	34	140	192	128	176	128	176	0	0	40	55	9.1 1840 / 2528
~~Hot~~ & Cold	1055	9.0	9.3	30	45	147	221	135	203	135	203	0	0	35	53	9.6 1920 / 2880
Test 7B																
Hot & Cold	1130	12.7	5.7	160	347	150	325	143	310	140	304	3	6.5 7	60	130	7.6 1720 / 3730
~~stable conditions~~																
Hot & Cold	1115	12.9	5.6	150	333	163	362	169	376	163	362	6	13	60	133	8.8 1760 / 3911
Test 7C																
Hot & Cold	1210	10.1	9.4	60	99	190	314	179	296	178	294	1	2	60	99	over 2000 / ~~7345~~
Test 7D	1400 condition change	5.3	13.2	580	665	140	161	125	143	125	143	0	0	56	64	over 2000 / ~~7245~~
	1410															
																$(SO_2)_{cor}$
7a	AVG.	8.2	10.3		56		207		189		188		1		29	2631
7b	AVG.	12.8	5.7		340		344		343		333		10		132	3421
	AVG.															

NOTE: Parts per million (ppm) figures are corrected to 3% O_2

15900

KVB

GASEOUS EMISSIONS DATA

TEST SITE ABMA SITE H
TEST NO. # 8 (PARTIC.)
DATE 3-29-79

FUEL SANDS HILL BIT. COAL
LOAD
CONDITIONS 75%, Norm O_2 + OFA
DATA TAKEN BY DJ

Probe Position	Time	O_2 % (dry)	CO_2 % (dry)	CO ppm(dry) unc	CO ppm(dry) cor	NO ppm(dry) unc	NO ppm(dry) cor	HOT LINE SAMPLES, PPM(WET) NOx unc	NOx cor	NO unc	NO cor	NO2 unc	NO2 cor	HC unc	HC cor	unc / cor Remarks SO_2
Cold	8:34	7.7	10.2	70	95	140	189									
Cold	900	7.9	10.4	80	110	130	179									
Cold	915	8.0	10.2	60	83	130	180									
Hot	943	9.0	9.6	40	60	142	213	132	198	132	198	0	0	37	56	1540 / 2310
Hot	10.00	8.3	10.3	38	54	145	206	125	177	125	177	0	0	55	80	1640 / 2324
Hot	1040	8.0	11.2	40	55	150	208	170	180	130	180	0	0	50	69	1760 / 2437
																$(SO_2)_{cor}$
	AVG.	8.2	10.3		76		196		185		185		0		68	2357
	AVG.															
	AVG.															

NOTE: Parts per million (ppm) figures are corrected to 3% O_2

15900

KVB

GASEOUS EMISSIONS DATA

TEST SITE ABMA SITE H
TEST NO. 9 (PARTIC.)
DATE 3-30-79

FUEL SANDS HILL COAL
LOAD 50%
CONDITIONS 50% - NORM OFA, NORM O_2
DATA TAKEN BY MJ

Probe Position	Time	O_2 % (dry)	CO_2 % (dry)	CO ppm(dry) unc	CO ppm(dry) cor	NO ppm(dry) unc	NO ppm(dry) cor	HOT LINE SAMPLES, PPM(WET) NOx unc	NOx cor	NO unc	NO cor	NO2 unc	NO2 cor	HC unc	HC cor	SO_2 Remarks unc	SO_2 Remarks cor
	8:10																
Cold	8.30	11.9	6.9	82	163	108	215										
Cold	850	11.5	7.4	65	124	120	228										
Cold	910	12.1	6.6	80	163	110	224										
Cold	930	12.5	6.1	101	215	115	245										
Cold	950	11.3	7.3	60	112	130	242										
HOT -	1015	11.2	7.1	60	111	145	268									1000	1845
Hot	1030	11.6	8.0	75	144	134	258	128	246	128	246	0		52	100	1040	2002
Hot	1045	11.7	7.1	90	175	138	268	126	245	125	243	1	2	48	93	1040	2025
Hot	1055	10.7	8.8	70	123	140	246	122	214	122	214	0		50	88	1100	1930
Hot	1110	11.5	7.5	80	152	130	247	125	238	125	238	0		49	93	1044	1988

KVB

GASEOUS EMISSIONS DATA

TEST SITE ABMA H
TEST NO. 10 A-D
DATE 3-30-79

FUEL SANDS HILL BIT. COAL
LOAD 50%
CONDITIONS VARY O_2, NORM OFA
DATA TAKEN BY Jackson

Probe Position	Time	O_2 % (dry)	CO_2 % (dry)	CO ppm(dry) unc	CO ppm(dry) cor	NO ppm(dry) unc	NO ppm(dry) cor	HOT LINE SAMPLES, PPM(WET) NOx unc	NOx cor	NO unc	NO cor	NO2 unc	NO2 cor	HC unc	HC cor	SO_2 Remarks unc	SO_2 Remarks cor
Hot+Cold	11 30	11.5	7.4	50	95	130	247	130	247	125	238	5	9	70	133	960	1828
Norm Bas																Test #	10A
Hot+Cold	12.00	12.8	5.7	120	216	140	265	109	240	109	240	0	0	51	113	730	1613
Norm Bas																	10B
Hot+Cold	12 35	9.2	9.2	41	63	160	245	145	232	145	222	0	0	50	76	1090	1668
Lower 1																Test #	10C
Hot+Cold	1248	10.4	8.6	50	85	148	252	138	235	142	242	-4	7	48	82	1040	1773
Sam 2																Test #	10D
Hot+Cold	1.40	13.7	5.8	180	448	115	286	112	278	112	278	0	0	51	127	700	1740
Higher																Test #	10E
	AVG.																
	AVG.																
	AVG.																

NOTE: Parts per million (ppm) figures are corrected to 3% O_2

15900

KVB

GASEOUS EMISSIONS DATA

TEST SITE ABMA SITE H
TEST NO. 11 (SASS & GORSOYR ROSS)
DATE 4-4-79

FUEL SANDS HILL BIT. COAL
LOAD
CONDITIONS MIN O_2, NORM OFA
DATA TAKEN BY M. Gabriel & R. Tidona

Probe Position	Time	O_2 % (dry)	CO_2 % (dry)	CO ppm(dry) unc	CO ppm(dry) cor	NO ppm(dry) unc	NO ppm(dry) cor	HOT LINE SAMPLES, PPM(WET) NOx unc	NOx cor	NO unc	NO cor	NO2 unc	NO2 cor	HC unc	HC cor	SO_2 Remarks unc. / cor
H	0905	9.65	9.0	110	174	215	341	195	309	195	309	0	0	21	33	1010 / 1602
Hot	1340	9.4	9.4	135	209	237	368	216	335	216	335	0	0	88	137	1020 / 1583
Hot	1410	9.7	8.8	120	191	242	385	218	347	218	347	0	0	90	143	1080 / 1720
Hot	1440	9.65	9.2	108	171	224	355	206	327	206	327	0	0	75	119	1260 / 1998
Hot	1500	9.13	9.2	165	250	210	318	185	281	185	281	0	0	88	133	1360 / 2062
Hot	1524	8.94	9.6	125	187	235	351	228	340	228	340	0	0	71	106	1090 / 1627
																$(SO_2)_{cor}$
	AVG.	9.4	9.2		197		353		323		323		0		112	1765
	AVG.															
	AVG.															

NOTE: Parts per million (ppm) figures are corrected to 3% O_2
Background HC reading (in ambient air) at end of test = 120 ppm

15900

KVB®

SO_x DATA SHEET (GOKSOYR-ROSS METHOD)

Test No. 11 Date 04-04-79 Location TEST SITE #

Unit No. — Fuel SANDS HILL COAL

Capacity 100 % Unit Type RILEY

Engr. RJT Conditions MIN O_2, NORM ΔA P_{BAR} = 29.10 "Hg

Meter Finish 456.721

Meter Start 454.850

Sample Volume Collected = 1.871 ADCF

Start Time	Stop Time	Elapsed Time (minutes)
12:25	12:50	25 minutes

Total Sampling Time = _____ min.

Time	Meter Vac. ("Hg)	Temperatures (°F)					Sample Flow Rate (ADCFM)
		Meter	Coil In	Coil Out	Water Bath	Stack	
12:25	5		103	115	129	540	0.075
12:30	↓		104	115	128	540	↓
1235	↓		112	114	137	536	↓
1240	↓		109	112	133	540	↓
12:45	↓		102	110	136	540	↓

NOTES: (1) Sample flow rate at meter should be 0.075 ADCFM or 0.01 cf/8 secs.

(2) Total sample volume collected should be ∿1.5 cf (∿ 20 minutes sampling time).

Date 6/14/79 K V B, INC. Test No. 11

SOx DATA SHEET

TEST NO. 11 UNIT NO. ____ FUEL Gas LOAD 100% klb/hr ____ Location 4

Box No.					
Time					
Temp. in Gas Meter					
Press. in Gas Meter					
Meter Reading					
Barom. Press.					
Percent Oxygen					
N_2 Purge Time					

Calculation: SO_3 or SO_2, ppm = $\frac{(A - B) \times N \times F \times (460 + T) \times 24}{V\ (P + p)}$

Excess O_2 _____%

	SO_2	SO_3	SO_x
A = Ml of ~~lead perchlorate~~ N.OH soln used for sample =	11.5	3.4	
B = Ml of ~~lead perchlorate~~ 10.92 used for blank =	2.0	0.7	
N = Normality of lead perchlorate titrant =	0.0236	0.0236	
F = Dilution factor =	20.0	1.0	
T = Average temp. in gas meter =	[illegible]		
V = Volume of gas sample ft3 =	[illegible]	[illegible]	
P = Barometric pressure =	29.10	[illegible]	
p = Pressure in gas meter =	[illegible]	[illegible]	
Concentration, C, ppm =	[illegible]	21	
C ppm corrected, gm/dscm =	2269	33	
Emission, E, g/Mcal =			
lb/MBtu =			
ng/J =			

$E = CF\left[\frac{2090}{20.9 - xO_2}\right]$

where

C = pollutant concentration, g/dscm

F, volume factor = _____dscm/10^4 cal

_____dscf/10^4 Btu

from Fed. Reg. 9/11/74 p 32856

60-14
rev. 1/2/75

SECTION 4.0

PARTICLE SIZE DISTRIBUTION

	PAGE
4.1 BRINK	64
4.2 SASS	67
4.3 BAHCO	68

KVB

BRINK CASCADE IMPACTOR DATA SHEET

TEST NO. 5 LOAD 100%

TEST SITE H % O_2 8

TEST DATE 3/26/79 FUEL Sands Hill Coal

SAMPLE LOCATION Blr. Out SPECIAL CONDITIONS Min. O_2, High OFA

GAS VELOCITY DETERMINATION

PITOT TUBE ΔP 0.14 BAROMETRIC PRESS in. Hg, P_{bar} 29.22

GAS TEMP. °R, Ts 910 GAS STATIC PRESS in. H_2O −0.245

PITOT CORRECTION FACTOR, Cp 0.837 GAS STATIC PRESS in. Hg abs, Ps 29.20

MOLECULAR WT. FLUE GAS, MWs 29.4

$$Vs = 85.48\ Cp\ \left(\frac{Ts\ \Delta P}{Ps\ MWs}\right)^{\frac{1}{2}} = 27.56 \text{ ft/sec}$$

IMPACTOR FLOW RATE DETERMINATION

NOZZLE DIAMETER inches, Dn 0.079

NOZZLE AREA ft^2, An 3.404×10^{-5} $An = \pi(Dn/24)^2$

$Qn = Vs\ An\ 60 = 5.811 \times 10^{-2}$ ft^3/min at nozzle

$Qc = Qs\ \left(\frac{PsMWs}{1.3Ts}\right)^{\frac{1}{2}} = 4.322 \times 10^{-2}$ ft^3/min corrected to calibration conditions

PRESSURE DROP ACROSS IMPACTOR FROM CALIBRATION CURVE 4.5 in. H_2O

OPERATING VACUUM (corrected for static pressure of duct) 4.7 in. H_2O

ISOKINETICS DETERMINATION

	SAMPLE TIME (θ)	METER READING (Vm)	METER TEMP (Tm)
INITIAL	10:06	451.911	35
FINAL	11:40	454.464	40
Δ	81 min.	2.513	38

$\%H_2O$ = 6 %

$$I = \frac{1.667\ Ts\ Vm\ P_{bar}}{\theta\ Tm\ Vs\ Ps\ An\left(1-\frac{\%H_2O}{100}\right)} = 107\ \%$$

#15900

KVB

BRINK CASCADE IMPACTOR LAB WORKSHEET

TEST No. 5 LOCATION ABMA SITE H

TEST DATE 3/24/79 ENGINEER TIDONA

TEST DESCRIPTION MIN O_2, HIGH OFA

PRE TEST WEIGHTS (GRAMS)

PLATE NO.		CYCLONE	1	2	3	4	5	FINAL FILTER
DATE WT.		3/20/79	3/24/79					
TARE WT.	1	100.0746	3.6601	3.3509	3.7344	3.2817	3.7558	0.0381
	2	100.0745	3.6607	3.3507	3.7344	3.2818	3.7558	0.0380
	3	100.0746	3.6608	3.3504	3.7343	3.2818	3.7558	0.0380
	4							
AVERAGE		100.0746	3.6605	3.3509	3.7344	3.2818	3.7558	0.0380

* filter became wet from condensate after test

POST TEST WEIGHTS (GRAMS)

DATE WT.								No good
GROSS WT.	1	100.0772	3.6626	3.3520	3.7350	3.2823	3.7561	.0626
	2	100.0769	3.6627	3.3521	3.7350	3.2823	3.7561	.0627
	3	100.0765	3.6626	3.3518	3.7349	3.2824	3.7565	.0629
	4							
AVERAGE		100.0769	3.6626	3.3520	3.7353	3.28233	3.75623	.06273

NET TEST RESULTS (MILLIGRAMS)

Not In Totals

NET WT.	.00233	.0018	.0011	.0009	.00053	.00043	.02473
PERCENT	32.9	25.4	15.5	12.7	7.5	6.1	

TOTAL NET WEIGHT 7.09 mgm

#15900

KVB

BRINK CASCADE IMPACTOR DATA REDUCTION

TEST NO. 5 LOAD 100 %

TEST SITE H % O_2 8

TEST DATE 3/26/79 FUEL Sands Hill Coal

SAMPLE LOCATION Blr. Out SPECIAL CONDITIONS Min. O_2, High OFA

ρ_p - Density of particles 2.5 g/cm^3 Vm - Dry gas volume 2.513 SCF

μ - Viscosity of flue gas 2.505 $\times 10^{-4}$ poise Mn - Total particulate mass 7.09 mgm

MWs - Molecular wt. flue gas 29.4 g/g mole Cn - Total concentration 0.044 grains/SCF

ΔP_I - Pressure drop across impactor 4.5 in H_2O I - Percent isokinetics 107 %

Ps - Absolute stack pressure 29.2 in. Hg Vs - Gas velocity 27.56 ft/sec.

Ts - Absolute stack temperature 910 °R Dn - Nozzle diameter 0.079 in.

Qs - Actual flow rate at stack conditions 0.0581 ft^3/min

Stage Number	CYCLONE	1	2	3	4	5	FINAL FILTER
Dj - Jet Diameter, cm		0.2490	0.1775	0.1396	0.0946	0.0731	
Fj - Press. factor, n.d.		0.0210	0.0273	0.0395	0.0903	0.3271	
$Ds_{,\overline{50}}$ Stokes diameter, µm		3.21	1.86	1.25	0.62	0.37	
$D_{A,\overline{50}}$ Aerodynamic diameter, µm		5.19	3.05	2.07	1.08	0.68	
$D_{AI,\overline{50}}$ Aerodynamic impaction diameter, µm		5.38	3.24	2.26	1.26	0.85	
Mn - Particulate mass, mgm	2.33	1.8	1.1	0.9	0.5	0.4	N.A.
% - Percent of Total	32.9	25.4	15.5	12.7	7.1	5.6	0
Cumulative percent	66.3	40.9	25.4	12.7	5.6	0	
Cn - Concentration, grains/SCF	0.014	0.011	0.007	0.006	0.003	0.002	N.A.
Cumulative concentration, grains/SCF	0.014	0.025	0.032	0.038	0.041	0.043	

SITE C

SASS GRAVIMETRICS

Test 11	10μ	17.1112	14.21 % passing
	3μ	1.9523	4.42 % passing
	1μ	0.2498	3.17 % passing
	Filter	0.6317	
	Total	19.9450 g	

KVB
6990-01
July 12, 1979

Sample No.	K-23148
Sample Description	Fly Ash H-3 3/22/79

Bahco Particle Size Determination

% Through #100 (149 Microns)	44.9

Results: Terminal Velocity	Diameter (Microns)	%Smaller
112.	25.	18.0
79.	21.	16.0
31.	13.	11.4
12.3	8.3	6.9
4.15	4.8	3.7
0.96	2.3	1.6
0.35	1.4	0.6

Density, gms/cc (On #100 Mesh Material Only)	2.47

Screen Sizing

% Through #10	100.0
16	96.1
30	90.4
50	71.5
100	44.9
200	22.3
325	13.3

SECTION 5.0

FUEL AND ASH ANALYSIS

		PAGE
5.1	COMMERCIAL TESTING ANALYSIS	70
5.2	COMBUSTIBLE ANALYSIS	82
5.3	COAL SIEVE ANALYSIS	83

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COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8434

PLEASE ADDRESS ALL CORRESPONDENCE TO:
16130 VAN DRUNEN RD., SOUTH HOLLAND, IL 60473
OFFICE TEL. (312) 264-1173

KVB, INC.
6176 Olson Memorial Highway
Minneapolis, MN 55422

April 16, 1979

Sample identification
by KVB, Inc.

Kind of sample reported to us	Coal
Sample taken at	-----
Sample taken by	KVB, Inc.
Date sampled	3/22/79
Date received	4/9/79

Site H
Test #3

Analysis report no. 71- 29662

PROXIMATE ANALYSIS

	As Received	Dry Basis
% Moisture	10.76	xxxxx
% Ash	7.10	7.96
% Volatile	35.88	40.21
% Fixed Carbon	46.26	51.83
	100.00	100.00
Btu/lb.	11773	13193
% Sulfur	1.57	1.76

FUSION TEMPERATURE OF ASH

	Reducing	Oxidizing
Initial Deformation	xxxx °F	xxxx °F
Softening (H = W)	xxxx °F	xxxx °F
Softening (H = ½W)	xxxx °F	xxxx °F
Fluid	xxxx °F	xxxx °F

H = Cone Height
W = Cone Width

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

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Charter Member

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KVB, INC.
6176 Olson Memorial Highway
Minneapolis, MN 55422

April 16, 1979

Sample identification
by KVB, Inc.

Kind of sample reported to us	Coal
Sample taken at	-----
Sample taken by	KVB, Inc.
Date sampled	3/26/79
Date received	4/9/79

Site H
Test #5

Analysis report no. 71- 29663

PROXIMATE ANALYSIS

	As Received	Dry Basis
% Moisture	13.01	xxxxx
% Ash	8.73	10.04
% Volatile	33.53	38.54
% Fixed Carbon	44.73	51.42
	100.00	100.00
Btu/lb.	11421	13129
% Sulfur	1.97	2.26

FUSION TEMPERATURE OF ASH

	Reducing	Oxidizing
Initial Deformation	xxxx °F	xxxx °F
Softening (H = W)	xxxx °F	xxxx °F
Softening (H = ½W)	xxxx °F	xxxx °F
Fluid	xxxx °F	xxxx °F

H = Cone Height
W = Cone Width

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OFFICE TEL. (312) 264-1173

April 25, 1979

KVB, INC.
6176 Olson Memorial Highway
Minneapolis, MN 55422

Sample identification by KVB, Inc.

Kind of sample reported to us: Coal

Sample taken at: Site H

Test #6

Sample taken by: KVB, Inc.

Date sampled: 3/27/79

Date received: 4/9/79

Analysis report no. 71- 29664

PROXIMATE ANALYSIS	As received	Dry basis
% Moisture	12.31	xxxxx
% Ash	12.34	14.07
% Volatile	33.43	38.13
% Fixed Carbon	41.92	47.80
	100.00	100.00
Btu/lb.	10577	12062
% Sulfur	1.82	2.08
% Alk. as Na_2O	xxxxx	0.23

SULFUR FORMS		
% Pyritic Sulfur	0.86	0.98
% Sulfate Sulfur	0.23	0.26
% Organic Sulfur	0.73	0.84

WATER SOLUBLE ALKALIES		
% Na_2O =	xxxxx	———
% K_2O =	xxxxx	———

FUSION TEMPERATURE OF ASH	Reducing	Oxidizing
Initial Deformation	2400 °F	——— °F
H is Cone Height; Softening (H = W)	2550 °F	——— °F
W is Cone Width; Softening (H = ½W)	2595 °F	——— °F
Fluid	2700+ °F	——— °F

% EQUILIBRIUM MOISTURE = ———

HARDGROVE GRINDABILITY INDEX = 43

FREE SWELLING INDEX = 1-1/2

*These ignited basis results were used to calculate undetermined value above

%Strontium oxide, SrO	0.00
%Barium oxide, BaO	0.10
%Manganese oxide, Mn_3O_4	0.02

72

% Weight

ULTIMATE ANALYSIS	As received	Dry basis
Moisture	12.31	xxxxx
Carbon	59.29	67.62
Hydrogen	4.15	4.73
Nitrogen	1.04	1.19
Chlorine	0.09	0.10
Sulfur	1.82	2.08
Ash	12.34	14.07
Oxygen (diff)	8.96	10.21
	100.00	100.00

MINERAL ANALYSIS OF ASH	% Weight Ignited Basis
Silica, SiO_2	47.93
Alumina, Al_2O_3	27.35
Titania, TiO_2	1.06
Ferric oxide, Fe_2O_3	16.19
Lime, CaO	1.59
Magnesia, MgO	0.72
Potassium oxide, K_2O	2.03
Sodium oxide, Na_2O	0.29
Sulfur trioxide, SO_3	0.78
Phos. pentoxide, P_2O_5	0.33
Undetermined	1.61
	100.00
SILICA VALUE =	72.15
BASE: ACID RATIO	0.27
T_{250} Temperature =	2595 °F

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

R. A. HOUSER, Manager, Midwest Division

Charter Member

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16130 VAN DRUNEN RD., SOUTH HOLLAND, IL 60473
OFFICE TEL. (312) 264-1173

KVB, INC.
6176 Olson Memorial Highway
Minneapolis, MN 55422

April 16, 1979

Sample identification by KVB, Inc.

Kind of sample reported to us	Coal
Sample taken at	-----
Sample taken by	KVB, Inc.
Date sampled	3/29/79
Date received	4/9/79

Site H
Test #8

Analysis report no. 71- 29665

PROXIMATE ANALYSIS

	As Received	Dry Basis
% Moisture	11.19	xxxxx
% Ash	9.62	10.83
% Volatile	36.21	40.77
% Fixed Carbon	42.98	48.40
	100.00	100.00
Btu/lb.	11201	12612
% Sulfur	2.06	2.32

FUSION TEMPERATURE OF ASH

	Reducing	Oxidizing
Initial Deformation	xxxx °F	xxxx °F
Softening (H = W)	xxxx °F	xxxx °F
Softening (H = ½W)	xxxx °F	xxxx °F
Fluid	xxxx °F	xxxx °F

H = Cone Height
W = Cone Width

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OFFICE TEL. (312) 264-1173

April 16, 1979

KVB, INC.
6176 Olson Memorial Highway
Minneapolis, MN 55422

Sample identification by KVB, Inc.

Site H
Test #9

Kind of sample reported to us	Coal
Sample taken at	-----
Sample taken by	KVB, Inc.
Date sampled	3/30/79
Date received	4/9/79

Analysis report no. 71- 29666

PROXIMATE ANALYSIS

	As Received	Dry Basis
% Moisture	10.90	xxxxx
% Ash	8.38	9.40
% Volatile	34.42	38.63
% Fixed Carbon	46.30	51.97
	100.00	100.00
Btu/lb.	11566	12981
% Sulfur	2.21	2.48

FUSION TEMPERATURE OF ASH

	Reducing	Oxidizing
Initial Deformation	xxxx °F	xxxx °F
Softening (H = W)	xxxx °F	xxxx °F
Softening (H = ½W)	xxxx °F	xxxx °F
Fluid	xxxx °F	xxxx °F

H = Cone Height
W = Cone Width

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16130 VAN DRUNEN RD., SOUTH HOLLAND, IL 60473
OFFICE TEL. (312) 264-1173

April 25, 1979

KVB, INC.
6176 Olson Memorial Highway
Minneapolis, MN 55422

Sample identification by KVB, Inc.

Kind of sample reported to us: Coal

Sample taken at: Site H

Test #11

Sample taken by: KVB, Inc.

Date sampled: 4/4/79

Date received: 4/9/79

Analysis report no. 71- 29667

PROXIMATE ANALYSIS	As received	Dry basis
% Moisture	11.20	xxxxx
% Ash	5.52	6.22
% Volatile	37.51	42.24
% Fixed Carbon	45.77	51.54
	100.00	100.00
Btu/lb.	11963	13473
% Sulfur	1.62	1.83
% Alk. as Na_2O	xxxxx	0.09
SULFUR FORMS		
% Pyritic Sulfur	0.96	1.08
% Sulfate Sulfur	0.00	0.00
% Organic Sulfur	0.66	0.75
WATER SOLUBLE ALKALIES		
% Na_2O =	xxxxx	———
% K_2O =	xxxxx	———

FUSION TEMPERATURE OF ASH	Reducing	Oxidizing
Initial Deformation	2010 °F	——— °F
Softening (H = W)	2175 °F	——— °F
Softening (H = ½W)	2215 °F	——— °F
Fluid	2495 °F	——— °F

H is Cone Height
W is Cone Width

% EQUILIBRIUM MOISTURE =	———
HARDGROVE GRINDABILITY INDEX =	49
FREE SWELLING INDEX =	2

ULTIMATE ANALYSIS	% Weight As received	Dry basis
Moisture	11.20	xxxxx
Carbon	67.17	75.65
Hydrogen	4.56	5.13
Nitrogen	1.11	1.25
Chlorine	0.05	0.06
Sulfur	1.62	1.83
Ash	5.52	6.22
Oxygen (diff)	8.77	9.86
	100.00	100.00

MINERAL ANALYSIS OF ASH	% Weight Ignited Basis
Silica, SiO_2	39.73
Alumina, Al_2O_3	23.32
Titania, TiO_2	1.12
Ferric oxide, Fe_2O_3	28.23
Lime, CaO	1.91
Magnesia, MgO	0.62
Potassium oxide, K_2O	1.74
Sodium oxide, Na_2O	0.23
Sulfur trioxide, SO_3	0.66
Phos. pentoxide, P_2O_5	0.36
Undetermined	1.99
	100.00
SILICA VALUE =	56.36
BASE: ACID RATIO	0.51
T_{250} Temperature =	2300 °F

*These ignited basis results were used to calculate undetermined value above

%Strontium oxide, SrO	0.00
%Barium oxide, BaO	0.07
%Manganese oxide, Mn_3O_4	0.02

Respectfully submitted,
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OFFICE TEL. (312) 264-1173

April 11, 1979

KVB, INC.
A Research-Cottrell Company
6176 Olson Memorial Highway
Minneapolis, Minnesota

Sample identification
by KVB, Inc.

Test # 3

Kind of sample reported to us	Bottom Ash
Sample taken at	Site H
Sample taken by	KVB, Inc.
Date sampled	3/22/79
Date received	4/9/79

Analysis report no. 71- 29656

	DRY
% COMBUSTIBLE	19.57
% SULFUR	0.58

Respectfully submitted,
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OFFICE TEL. (312) 264-1173

KVB, INC.
A Research-Cottrell Company
6176 Olson Memorial Highway
Minneapolis, Minnesota

April 11, 1979

Sample identification by KVB, Inc.

Kind of sample reported to us	Bottom Ash
Sample taken at	Site H
Sample taken by	KVB, Inc.
Date sampled	3/26/79
Date received	4/9/79

Test # 5

Analysis report no. 71- 29657

	DRY
% COMBUSTIBLE	20.72
% SULFUR	0.75

Respectfully submitted,
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KVB, INC.
A Research-Cottrell Company
6176 Olson Memorial Highway
Minneapolis, Minnesota

April 11, 1979

Sample identification by KVB, Inc.

Kind of sample reported to us	Bottom Ash
Sample taken at	Site H
Sample taken by	KVB, Inc.
Date sampled	3/27/79
Date received	4/9/79

Test # 6

Analysis report no. 71- 29658

	DRY
% COMBUSTIBLE	14.56
% SULFUR	0.30

Respectfully submitted,
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KVB, INC.
A Research-Cottrell Company
6176 Olson Memorial Highway
Minneapolis, Minnesota

April 11, 1979

Sample identification by KVB, Inc.

Kind of sample reported to us	Bottom Ash
Sample taken at	Site H
Sample taken by	KVB, Inc.
Date sampled	3/29/79
Date received	4/9/79

Test # 8

Analysis report no. 71- 29659

	DRY
% COMBUSTIBLE	18.18
% SULFUR	0.77

Respectfully submitted,
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KVB, INC.
A Research-Cottrell Company
6176 Olson Memorial Highway
Minneapolis, Minnesota

April 11, 1979

Sample identification by KVB, Inc.

Kind of sample reported to us	Bottom Ash
Sample taken at	Site H
Sample taken by	KVB, Inc.
Date sampled	3/30/79
Date received	4/9/79

Test # 9

Analysis report no. 71- 29660

	DRY
% COMBUSTIBLE	18.10
% SULFUR	0.50

80

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R. A. HOUSER, Manager, Midwest Division

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KVB, INC.
A Research-Cottrell Company
6176 Olson Memorial Highway
Minneapolis, Minnesota

April 11, 1979

Sample identification by KVB, Inc.

Kind of sample reported to us	Bottom Ash
Sample taken at	Site H
Sample taken by	KVB, Inc.
Date sampled	4/4/79
Date received	4/9/79

Test # 11

Analysis report no. 71- 29661

	DRY
% COMBUSTIBLE	7.10
% SULFUR	0.24

Respectfully submitted,
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R. A. HOUSER, Manager, Midwest Division

Charter Member

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COMBUSTIBLES DATA SHEET

SITE #4 - BLR CNT

Crucible Number	Sample Origin	Crucible Weight grams	Crucible & Sample Weight Post 110°C gms	Sample Weight grams	Post 750°C grams	Δ Weight grams	% Combustibles
36	TEST #5	9.4569	10.2304	0.7732	10.0525	0.1779	23.0
	3-26-79	9.4566	10.2306		10.0528		
		9.4578	10.2300		—		
	AVG.	9.4571	10.2303		10.0524		
38	TEST #6	10.1458	10.6454	0.4991	10.5193	0.1260	25.2
	3-27-79	10.1457	10.6452		10.5191		
		10.1468	10.6450		—		
	AVG.	10.1461	10.6452		10.5192		
39	TEST #8	9.9974	10.2433	0.2456	10.1685	.0751	30.5
	3-27-79	9.9973	10.2436		10.1680		
		9.9986	10.2432		—		
	AVG.	9.9978	10.2434		10.1683		
23	TEST #9	10.1023	10.6597	0.5574	10.4734	0.1863	33.4
	3-30-79	10.1024	10.6597		10.4734		
		10.1023					
	AVG.	10.1023	10.6597		10.4734		
	AVG.						
	AVG.						
	AVG.						
	AVG.						
	AVG.						
	AVG.						
	AVG.						

KVB

SIEVE ANALYSIS TEST REPORT

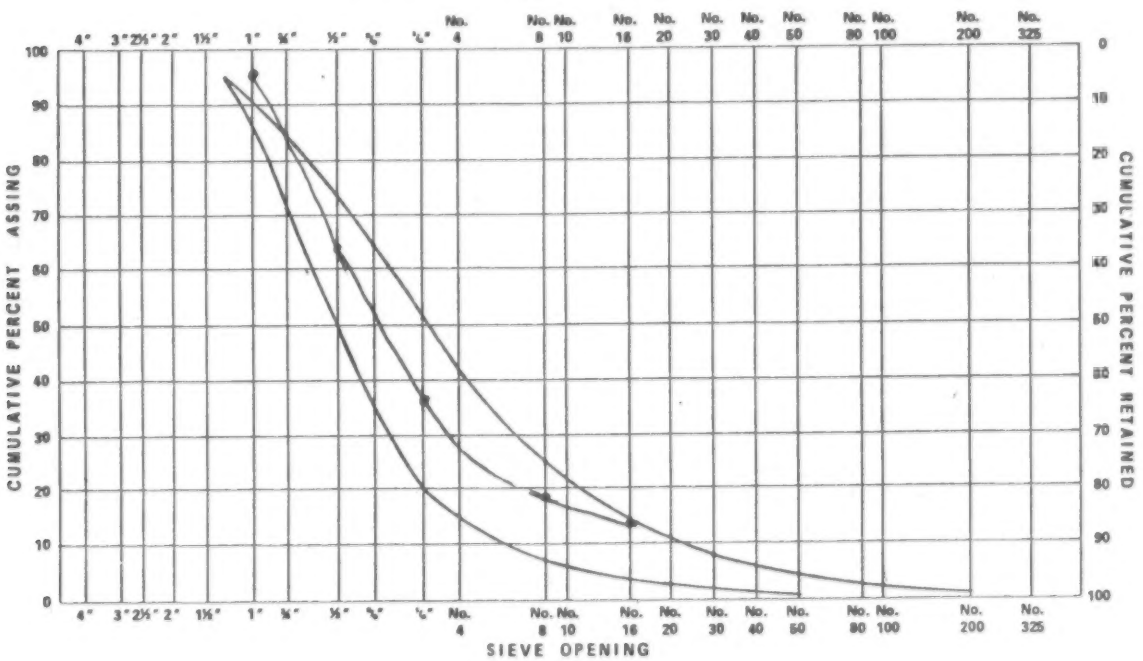
TEST NO. 3 DATE SAMPLE TAKEN 3-22-79

TEST SITE H TEST PERFORMED BY TIDWA

SAMPLE IDENTIFICATION SANDS HILL BITUMINOUS COAL

Screen Size Passing	Tare Weight (gm)	Gross Weight (gm)	Net Weight (gm)	Percent (%)	Cumulative Weight Passing (gm)	Cumulative Percent Passing (%)	Sieve Shaker Duration (min)
Top			197.1	4.15	4748.4	100.00	1
1"			1198.3 348.2 1546.5	32.57	4551.3	95.85	2
½"			1268.3	26.71	3004.8	63.28	4
¼"			857.9	18.07	1736.5	36.57	8
No 8			247.1	5.20	878.6	18.50	16
No 16			631.5	13.30	631.5	13.30	16

Totals = 4748.4 100.00


4" 3" 2½" 2" 1½" 1" ¾" ½" ⅜" ¼" No. 4 No. 8 No. 10 No. 16 No. 20 No. 30 No. 40 No. 50 No. 80 No. 100 No. 200 No. 325
CUMULATIVE PERCENT PASSING
CUMULATIVE PERCENT RETAINED
SIEVE OPENING

15900

KVB

SIEVE ANALYSIS TEST REPORT

TEST NO. 5

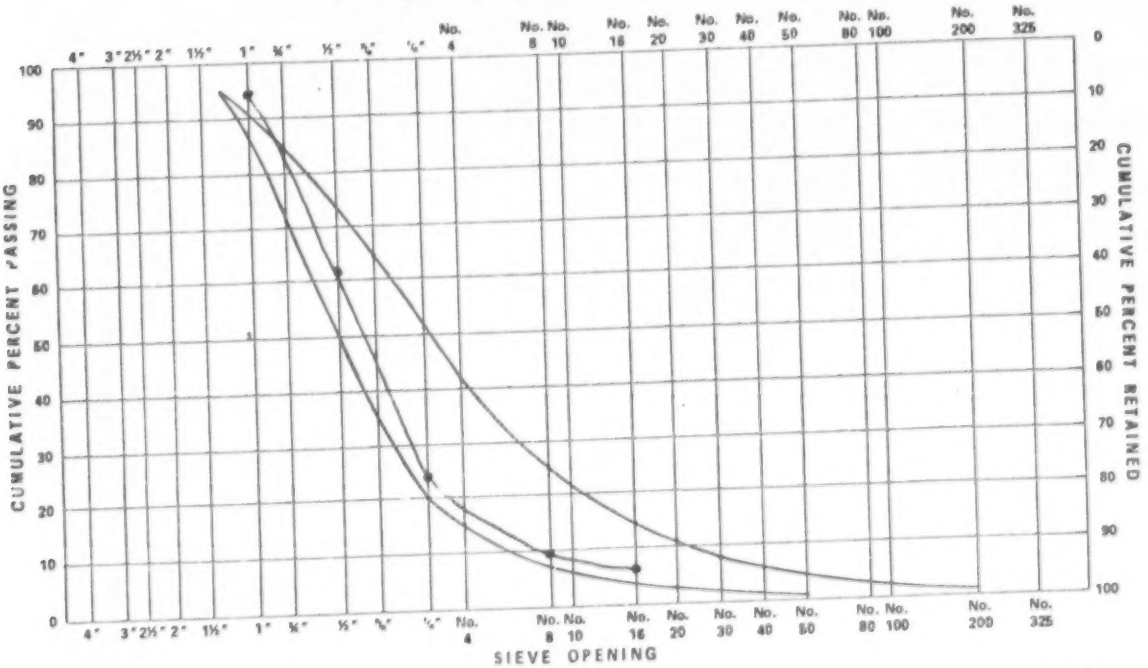
TEST SITE H

SAMPLE IDENTIFICATION SANDS HILL BIT. COAL

DATE SAMPLE TAKEN 3-26-79

TEST PERFORMED BY TIDANA

Screen Size Passing	Tare Weight (gm)	Gross Weight (gm)	Net Weight (gm)	Percent (%)	Cumulative Weight Passing (gm)	Cumulative Percent Passing (%)	Sieve Shaker Duration (min)
Top			234.8	5.18	4532.6	100.0	0
1"			1537.5	33.92	4297.8	94.8	1
½"			1693.8	37.37	2760.3	60.9	2
¼"			621.0	13.70	1066.5	23.5	4
No. 8			154.4	3.41	445.5	9.8	8
No. 16			291.1	6.42	291.1	6.4	16
		Totals =	4532.6	100.00			


4" 3" 2½" 2" 1½" 1" ¾" ½" ⅜" ¼" No. 4 No. 8 No. 10 No. 16 No. 20 No. 30 No. 40 No. 50 No. 80 No. 100 No. 200 No. 325
CUMULATIVE PERCENT PASSING
CUMULATIVE PERCENT RETAINED
SIEVE OPENING

15900

KVB

SIEVE ANALYSIS TEST REPORT

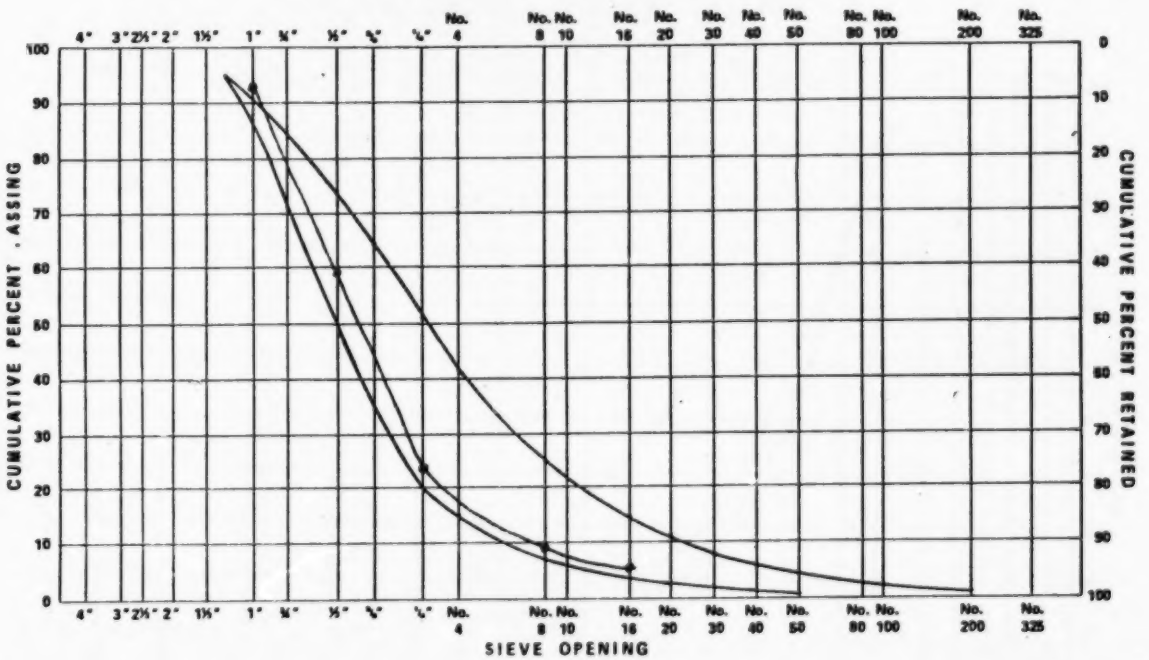
TEST NO. 6 DATE SAMPLE TAKEN 3-27-79

TEST SITE H TEST PERFORMED BY TIDONA

SAMPLE IDENTIFICATION SANDS HILL BIT. COAL

Screen Size Passing	Tare Weight (gm)	Gross Weight (gm)	Net Weight (gm)	Percent (%)	Cumulative Weight Passing (gm)	Cumulative Percent Passing (%)	Sieve Shaker Duration (min)
Top			274.4	7.32	3749.4	100.0	0
1"			1246.6	33.25	3475.0	92.7	1
½"			1360.3	36.28	2228.4	59.4	2
¼"			516.2	13.77	868.1	23.2	4
No.8			118.4	3.16	351.9	9.4	8
No.16			233.5	6.23	233.5	6.2	16

Totals = 3749.4 100.01


4" 3" 2½" 2" 1½" 1" ¾" ½" ⅜" ¼" No. 4 No. 8 No. 10 No. 16 No. 20 No. 30 No. 40 No. 50 No. 80 No. 100 No. 200 No. 325
100 90 80 70 60 50 40 30 20 10 0
CUMULATIVE PERCENT PASSING
CUMULATIVE PERCENT RETAINED
SIEVE OPENING

15900

KVB

SIEVE ANALYSIS TEST REPORT

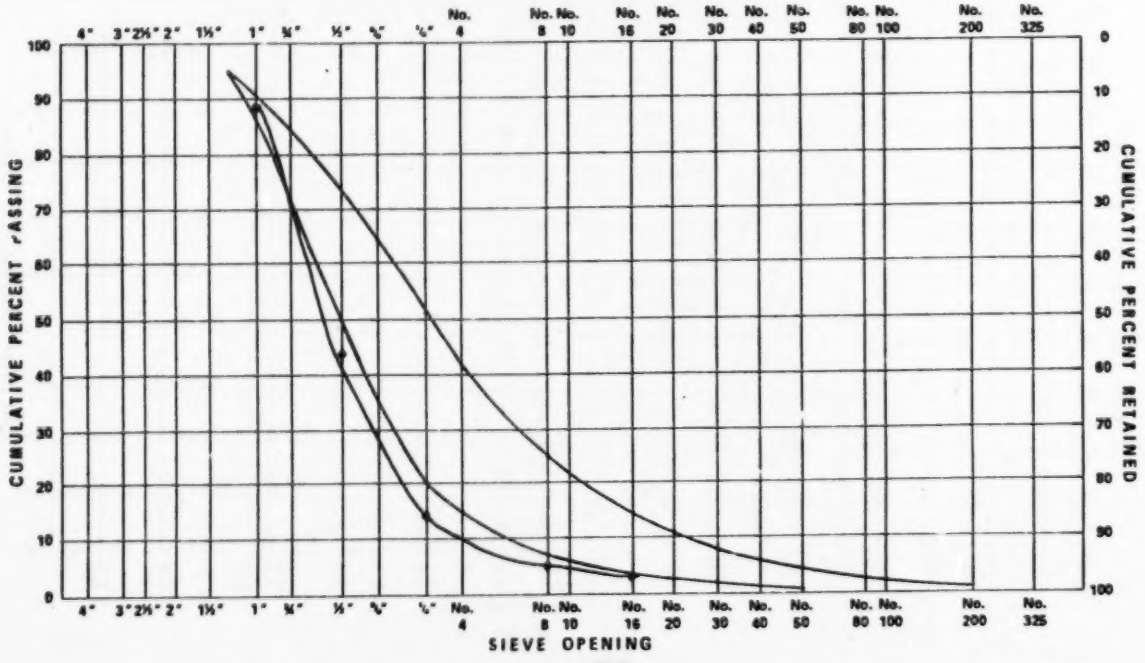
TEST NO. 8 DATE SAMPLE TAKEN 3-29-79

TEST SITE H TEST PERFORMED BY TIDONA

SAMPLE IDENTIFICATION SANDS HILL BITUMINOUS COAL

Screen Size Passing	Tare Weight (gm)	Gross Weight (gm)	Net Weight (gm)	Percent (%)	Cumulative Weight Passing (gm)	Cumulative Percent Passing (%)	Sieve Shaker Duration (min)
Top			552.6	11.54	4788.6	100.0	0
1"			2128.6	44.45	4236.0	88.5	1
½"			1419.6	29.65	2107.4	44.0	2
¼"			438.4	9.15	687.8	14.4	4
No. 8			97.2	2.03	249.4	5.2	8
No. 16			152.2	3.18	152.2	3.2	16

Totals = 4788.6 100.00


4" 3" 2½" 2" 1½" 1" ¾" ½" ⅜" ¼" No. 4 No. 8 No. 10 No. 16 No. 20 No. 30 No. 40 No. 50 No. 80 No. 100 No. 200 No. 325
100 90 80 70 60 50 40 30 20 10 0
CUMULATIVE PERCENT PASSING
CUMULATIVE PERCENT RETAINED
SIEVE OPENING

15900

KVB

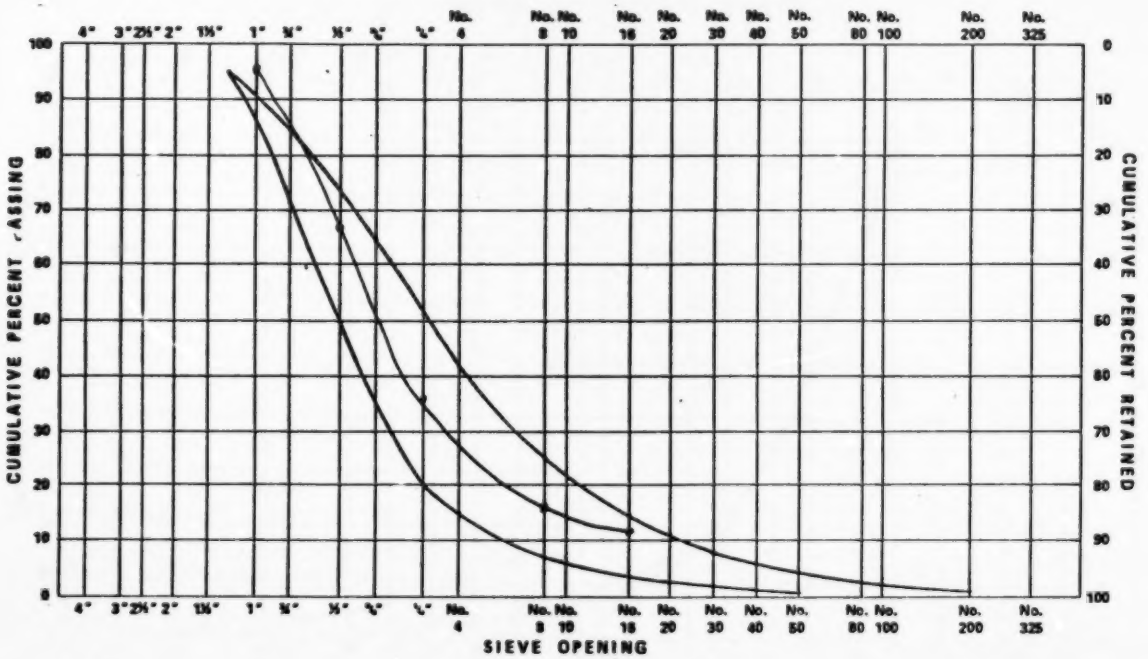
SIEVE ANALYSIS TEST REPORT

TEST NO. 9 DATE SAMPLE TAKEN 3-30-79

TEST SITE H TEST PERFORMED BY SLC

SAMPLE IDENTIFICATION SANDS HILL RIT. COAL

Screen Size Passing	Tare Weight (gm)	Gross Weight (gm)	Net Weight (gm)	Percent (%)	Cumulative Weight Passing (gm)	Cumulative Percent Passing (%)	Sieve Shaker Duration (min)
TOP			203.2	4.91	4139.0	100.0	1
1"			1157.1	27.96	3935.8	95.1	2
½"			1297.2	31.34	2778.7	67.1	4
¼"			810.7	19.35	1481.5	35.8	8
4			221.2	5.34	680.8	16.4	16
16			459.6	11.10	459.6	11.1	
		Totals=	4139.0	100.00			


4" 3" 2½" 2" 1½" 1" ¾" ½" ⅜" ¼" No. 4 No. 8 No. 10 No. 16 No. 20 No. 30 No. 40 No. 50 No. 80 No. 100 No. 200 No. 325
CUMULATIVE PERCENT PASSING
CUMULATIVE PERCENT RETAINED
SIEVE OPENING

15900

KVB

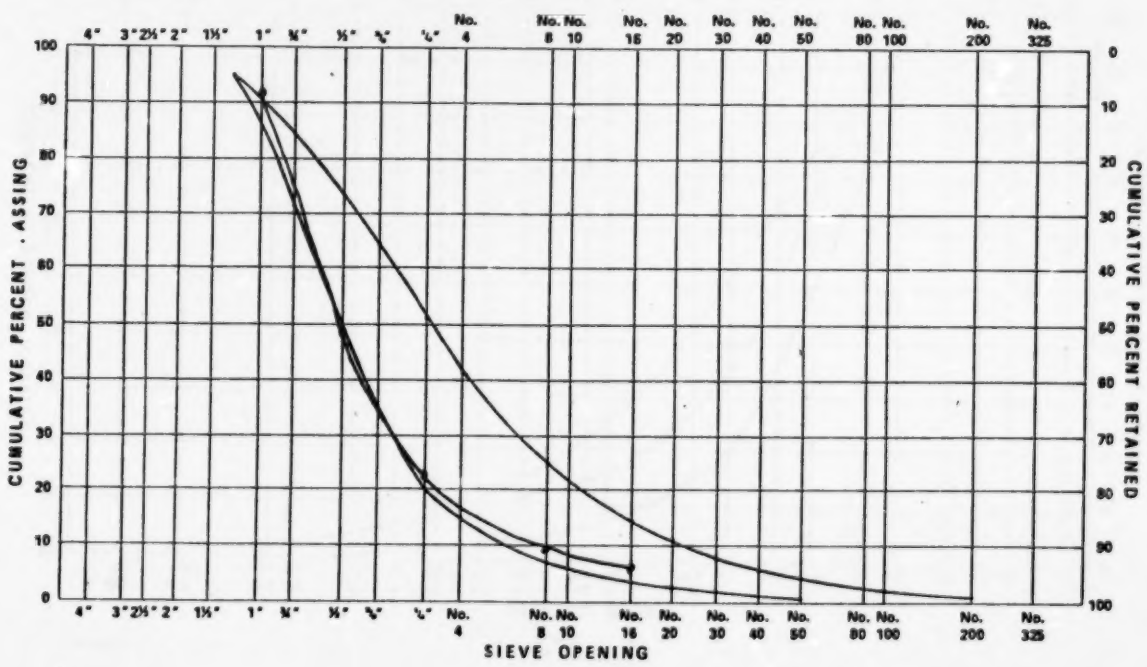
SIEVE ANALYSIS TEST REPORT

TEST NO. 11 DATE SAMPLE TAKEN 4-4-79

TEST SITE H TEST PERFORMED BY Tidona

SAMPLE IDENTIFICATION SANDS HILL BITUM. COAL

Screen Size Passing	Tare Weight (gm)	Gross Weight (gm)	Net Weight (gm)	Percent (%)	Cumulative Weight Passing (gm)	Cumulative Percent Passing (%)	Sieve Shaker Duration (min)
Top			313.6	8.48	3696.3	100.0	0
1"			1591.3	43.05	3382.7	91.5	1
½"			978.1	26.46	1791.4	48.5	2
¼"			454.2	12.29	813.3	22.0	4
No.8			106.7	2.89	359.1	9.7	8
No.16			252.4	6.83	252.4	6.8	16
		Totals =	3696.3	100.00			


4" 3" 2½" 2" 1½" 1" ¾" ½" ⅜" ¼" No. 4 No. 8 No. 10 No. 16 No. 20 No. 30 No. 40 No. 50 No. 80 No. 100 No. 200 No. 325
100 90 80 70 60 50 40 30 20 10 0
CUMULATIVE PERCENT PASSING
CUMULATIVE PERCENT RETAINED
SIEVE OPENING

15900

SECTION 6.0

OVERFIRE AIR TRAVERSES

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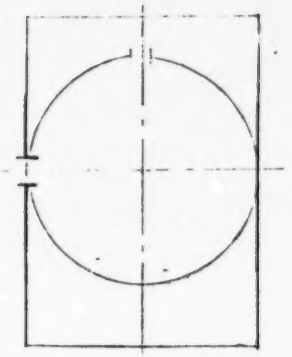
6.1 OVERFIRE AIR DATA SHEETS	90

OVERFIRE AIR TRAVERSE
SMOKESTACK FLOW PROFILE



1 of 3

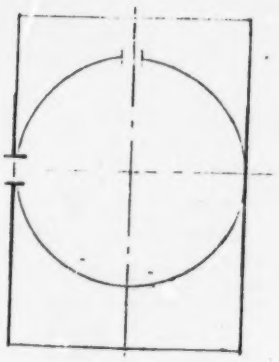
TEST NO. 4 , min OFA
LOCATION NO. ABMA SITE H
DATE 3-23-79
SAMPLING LOCATION OFA duct
INSIDE OF FAR WALL TO
OUTSIDE OF NIPPLE, (DISTANCE A) BAROMETRIC PRESS, in.Hg 28.92
INSIDE OF NEAR WALL TO
OUTSIDE OF NIPPLE, (DISTANCE B) STACK PRESS., Ps, iwg 2.8
STACK I.D. (DISTANCE A - DISTANCE B) 12" STK. GAS SP. GRAVITY, G_s 1.0
NEAREST UPSTREAM DISTURBANCE 2 duct diam
NEAREST DOWNSTREAM DISTURBANCE 1 " "

OFA press. = 2.8 "H_2O

TRAVERSE POINT NUMBER	% OF STACK DIAMETER	DISTANCE FROM INSIDE WALL	VELOCITY HEAD (Δp_s), in. H_sO	STACK TEMPERATURE (T_s, °F	OXYGEN %	STACK GAS SPEED, Vs ft/min
1.	8.5	1"	-0.15			
2.	12.5	1½"	-0.11			
3.	16.9	2"	0.0			
4.	22.0	2⅝"	+0.16			
5.	28.3	3⅜"	+0.26			
6.	37.5	4½"	0.0			
7.	62.5	7½"	-0.26			
8.	71.7	8⅝"	-0.22			
9.	78.0	9⅜"	-0.17			
10.	83.1	10"	-0.21			
11.	87.5	10½"	-0.21			
12.	91.5	11"	-0.24			
13.						
14.						
15.						
16.						
17.						
18.						
Average						

STACK GAS SPEED, $V_s = 174\ F_s \sqrt{\Delta P (T_s + 460)\ (\frac{407}{P_s})\ (\frac{1.00}{G_s})}$ Average

OVERFIRE AIR TRAVERSE
SMOKESTACK FLOW PROFILE



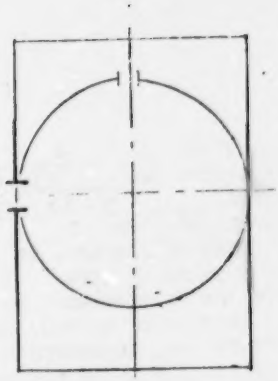
TEST NO. 4
LOCATION NO. ABMA H
DATE 3-23-79
SAMPLING LOCATION
INSIDE OF FAR WALL TO
OUTSIDE OF NIPPLE, (DISTANCE A) BAROMETRIC PRESS, in.Hg
INSIDE OF NEAR WALL TO
OUTSIDE OF NIPPLE, (DISTANCE B) STACK PRESS., Ps, iwg 7.2
STACK I.D. (DISTANCE A - DISTANCE B) 12' STK. GAS SP. GRAVITY, G_s
NEAREST UPSTREAM DISTURBANCE
NEAREST DOWNSTREAM DISTURBANCE

2 of 3

OFA press. = 7.2 "H_2O

TRAVERSE POINT NUMBER	% OF STACK DIAMETER	DISTANCE FROM INSIDE WALL	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s, °F	OXYGEN %	STACK GAS SPEED, Vs ft/min
1.	8.5	1"	+0.31			
2.	12.5	1½"	+0.34			
3.	16.9	2"	+0.41			
4.	22.0	2⅝"	+0.51			
5.	28.3	3¾"	+1.25			
6.	32.5	4½"	+1.20			
7.	62.5	7½"	+1.65			
8.	71.7	8⅜"	+0.58			
9.	78.0	9⅜"	+0.34			
10.	83.1	10"	+0.25			
11.	87.5	10½"	+0.20			
12.	91.5	11"	+0.17			
13.						
14.						
15.						
16.						
17.						
18.						
Average						

STACK GAS SPEED, $V_s = 174\ F_s \sqrt{\Delta P (T_s + 460)\ \left(\frac{407}{P_s}\right)\ \left(\frac{1.00}{G_s}\right)}$ (Average)



3 of 3

OVERFIRE AIR TRAVERSE
SMOKESTACK FLOW PROFILE

TEST NO. 4
LOCATION NO. ABMA H
DATE 3-23-79
SAMPLING LOCATION
INSIDE OF FAR WALL TO
OUTSIDE OF NIPPLE, (DISTANCE A) BAROMETRIC PRESS, in.Hg
INSIDE OF NEAR WALL TO
OUTSIDE OF NIPPLE, (DISTANCE B) STACK PRESS., Ps, iwg 11.2
STACK I.D. (DISTANCE A - DISTANCE B) 12" STK. GAS SP. GRAVITY, G_S
NEAREST UPSTREAM DISTURBANCE
NEAREST DOWNSTREAM DISTURBANCE

OFA press. = 11.2" H_2O

TRAVERSE POINT NUMBER	% OF STACK DIAMETER	DISTANCE FROM INSIDE WALL	VELOCITY HEAD (ΔP_s), in. H_s0	STACK TEMPERATURE (T_s, °F	OXYGEN %	STACK GAS SPEED, Vs ft/min
1.	8.5	1"	+0.03			
2.	12.5	1½"	-0.05			
3.	16.9	2"	+0.07			
4.	27.0	2 5/8"	+0.08			
5.	28.3	3 3/8"	+0.24			
6.	37.5	4½"	+0.66			
7.	62.5	7½"	+0.47			
8.	71.7	8 5/8"	+1.25			
9.	78.0	9 3/8"	+1.35			
10.	83.1	10"	+1.05			
11.	87.5	10½"	+0.67			
12.	91.5	11"	+0.42			
13.						
14.						
15.						
16.						
17.						
18.						
Average						

STACK GAS SPEED, $V_s = 174\ F_s \sqrt{\Delta P (T_s + 460)\ (\frac{407}{P_s})\ (\frac{1.00}{G_s})}$ (Average)